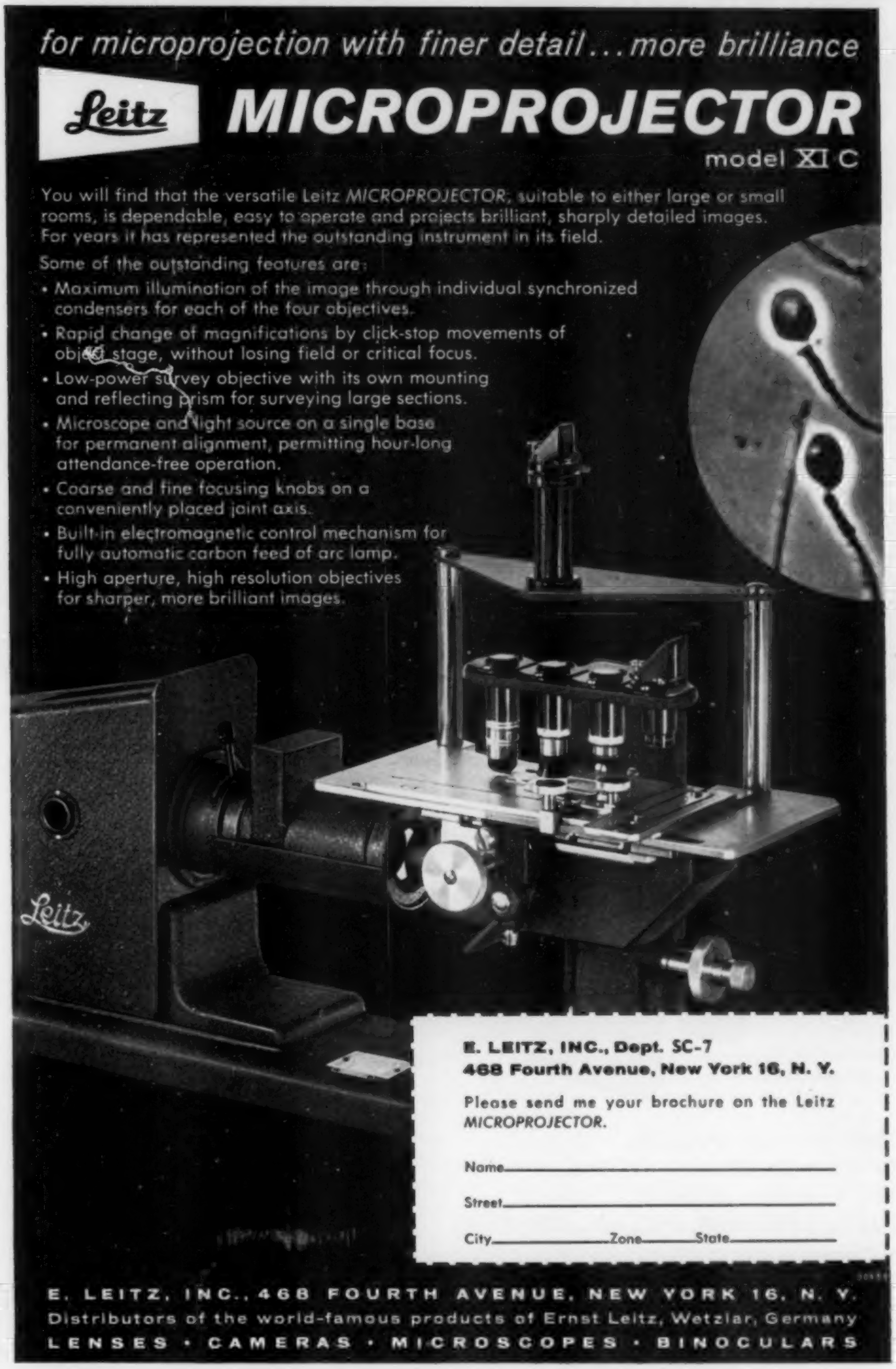
SCIENCE

22 July 1955

Volume 122, Number 3160

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SCIENCE is published weekly by the AAAS, 1515 Massachusetts Ave., NW, Washington 5, D. C. Entered at the Lancaster, Pa., Post Office as second class matter under the act of 3 March 1879. Annual subscriptions: $7.50; foreign postage, $1; Canadian postage, 50¢.


for microprojection with finer detail... more brilliance
Leitz
MICROPROJECTOR
model XI C
You will find that the versatile Leitz MICROPROJECTOR, suitable to either large or small rooms, is dependable, easy to operate and projects brilliant, sharply detailed images. For years it has represented the outstanding instrument in its field.
Some of the outstanding features are:
• Maximum illumination of the image through individual synchronized condensers for each of the four objectives.
• Rapid change of magnifications by click-stop movements of object stage, without losing field or critical focus.
• Low-power survey objective with its own mounting and reflecting prism for surveying large sections.
• Microscope and light source on a single base for permanent alignment, permitting hour-long attendance-free operation.
• Coarse and fine focusing knobs on a conveniently placed joint axis.
• Built-in electromagnetic control mechanism for fully automatic carbon feed of arc lamp.
• High aperture, high resolution objectives for sharper, more brilliant images.
Leitz
E. LEITZ, INC., Dept. SC-7
468 Fourth Avenue, New York 16, N. Y.
Please send me your brochure on the Leitz MICROPROJECTOR.
Name
Street
City Zone State
E. LEITZ, INC., 468 FOURTH AVENUE, NEW YORK 16, N. Y.
Distributors of the world-famous products of Ernst Leitz, Wetzlar, Germany
LENSES • CAMERAS • MICROSCOPES • BINOCULARS

22 July 1955, Volume 122, Number 3160

SCIENCE

SCIENCE, founded in 1880, is published each Friday by the American Association for the Advancement of Science at Business Press, Lancaster, Pa. Entered at the Lancaster, Pa., Post Office as second class matter under the Act of 3 March 1879.

SCIENCE is indexed in the *Reader's Guide to Periodical Literature*.

All correspondence should be addressed to SCIENCE 1515 Massachusetts Ave., NW, Washington 5, D.C. Manuscripts should be typed with double spacing and submitted in duplicate. The AAAS assumes no responsibility for the safety of manuscripts or for the opinions expressed by contributors.

Change of address: The notification should reach us 4 weeks in advance. If possible, please furnish an address stencil label from a recent issue. Be sure to give both old and new addresses, including zone numbers, if any.

Annual subscriptions: $7.50; foreign postage, $1; Canadian postage, 50¢. Single copies, 25¢. Special rates to members of the AAAS. Cable address: Advancesci, Washington.

The AAAS also publishes THE SCIENTIFIC MONTHLY.

Preparation of Graphs for *Science*

Not more than three or four *curves* ordinarily should be shown on the same graph, although more may be included in the case of a family of well-separated curves. Use a solid line for an especially important curve and dashed, dotted, or lighter solid lines for the other curves. No curve or coordinate ruling of the graph should run through any lettering or outlined circles, triangles, and so forth, that are used to indicate plotted points.

Coordinate rulings should be limited in number to those needed to guide the eye in making a reading to the desired degree of approximation. Short scale markers, or "ticks," may be inserted between rulings if this is desirable. The rulings should be light enough not to distract attention from the curves that are being presented.

Lettering should be placed so that it can be read easily from the bottom and from the right-hand side of the graph; that is, the lettering should face either the bottom or the right-hand side of the drawing.

A graph should be free of all lines and lettering that are not essential for clear understanding. As far as is practicable, explanatory comments, supplementary data, or formulas should be placed in the figure legend or in the text. The exception to this rule is the case where there are several curves on the same graph that need separate identification; if practicable, they should be identified by brief labels placed close to the curve (horizontally or along the curve) rather than by single letters or numbers that require a key.

If it seems necessary to place supplementary information on the drawing proper, the lettering should be kept within the vertical and horizontal limits of the curves or other essential features of the drawing. Otherwise the space occupied by the drawing may be needlessly large, or else the drawing may have to be reduced in reproduction, often to the point where the lettering or other details are illegible.

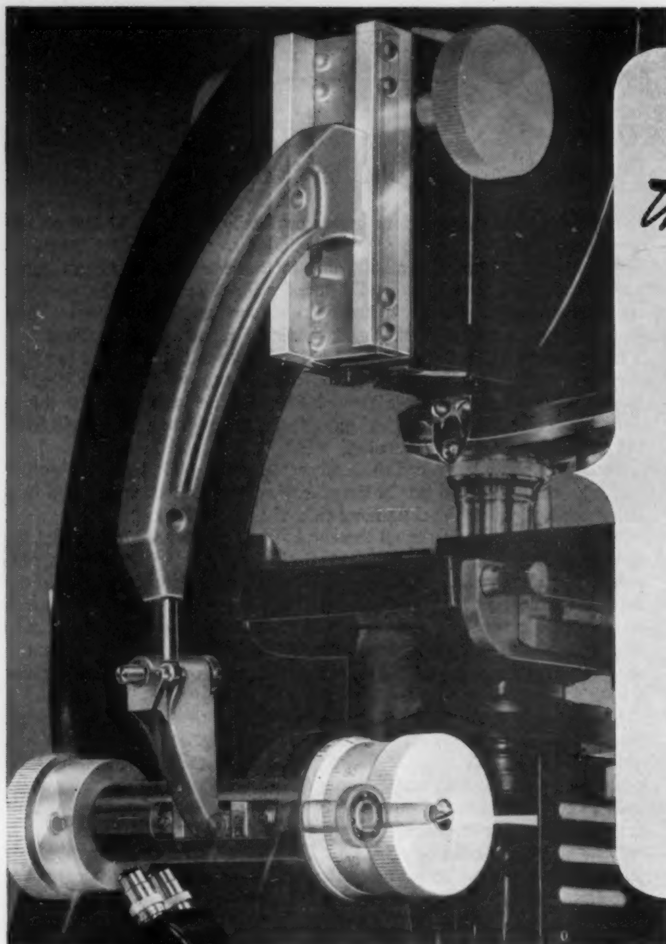
Scale captions should be placed outside the grid area, usually at the bottom for the horizontal scale and at the left-hand side for the vertical scale. The scale caption should consist of (i) the name of the variable plotted, (ii) its symbol, if one is used in the text, and (iii) in parentheses, the abbreviation for the unit of measure; thus, Pressure p ($lb/in.^2$). Avoid using such captions as "Pressure in $lb/in.^2$" and "Pressure in lb per sq in." The technical terms, symbols, and abbreviations on a drawing should be in accord with those used in the text of the article.

The *horizontal and vertical scales* for a graph should be chosen with care, so as to give a correct impression of the relationship plotted, for the choice of scales has a controlling influence on the apparent rate of change of the dependent variable. Except where a visual comparison of plotted magnitudes is important, the bottom (abscissa) and extreme left-hand (ordinate) coordinate lines need not represent the zero values of the variables plotted; this often results in a more effective graph as well as a saving of space.

The numerals representing the scale values should be placed outside the grid area. If the scale values are smaller than unity and are expressed in decimal form, a cipher should always precede the decimal point; thus 0.20, not .20. The use of many ciphers in scale numbers should be avoided, and the best way to do this is to reexpress the quantity plotted in terms of a larger unit of measurement. For example, suppose that originally the scale numbers are 15 000, 20 000, 25 000 . . . and that the scale caption is "Pressure ($lb/in.^2$)"; these scale numbers can be changed to 15, 20, 25 . . . , provided that the unit is changed to 10^3 $lb/in.^2$ If, in this example, the data are correct to three significant figures and it is desirable to indicate this fact, then the scale figures should be 1.50, 2.00, 2.50 . . . , and the unit, 10^4 $lb/in.^2$. *Never* use captions of the types: "Velocity $\times 10^3$ in ft/sec" and "Velocity (ft/sec $\times 10^3$)." They are ambiguous, since they do not indicate clearly whether the scale numbers *have been* or *are to be* multiplied by 10^3.

For instructions on paper, ink, size, and legends, see *Science* **122**, 103 (15 July 1955).

[These suggestions are condensed from D. R(oller), *Science* **120**, 5A (17 Sept. 1954).]

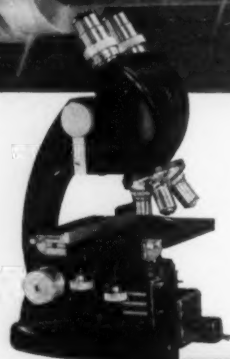


the Inside Story

of BAUSCH & LOMB GLIDE MOTION FOCUS

Fastest, easiest, most critical focus in microscope history!

- **Glides smoothly into perfect focus—ball bearings and rollers throughout!**
- ***Stays* in perfect focus . . . radial thrust ball bearing makes backlash impossible!**



You'll find this silk-smooth, easy focus a new experience in microscopy. From the convenient hand-height control to the eyepieces, the entire focusing system floats on specially tempered bearings and rollers . . . cushioned against wear or uneven travel . . . for a lifetime of precision performance. Here's the closest thing to theoretical friction-proof motion that has ever been achieved in microscope design! Another *exclusive* advantage of Bausch & Lomb Laboratory Microscopes, the world's finest.

BAUSCH & LOMB

SINCE B&L 1853

Write for demonstration and Catalog D-185. Bausch & Lomb Optical Co., 64270 St. Paul Street, Rochester 2, New York.

Dynoptic **LABORATORY MICROSCOPES**

22 July 1955, Volume 122, Number 3160 SCIENCE

Improving Science Teaching

AAAS Cooperative Committee on the
Teaching of Science and Mathematics

Only 249 men and women who had prepared to teach high-school physics graduated from colleges and universities in the United States this spring. And only half of these few graduates—if recent experience serves as a guide—will actually be teaching high-school classes next fall. The other half will have been diverted into other occupations by more attractive employment opportunities, will be in military service, or for other reasons will not be teaching.

One hundred twenty-five new physics teachers are clearly far too few to replace those lost through death, retirement, and resignation from the nation's 25,000 high schools and to teach the additional classes called for by an enrollment that is already well above the 6 million of 3 or 4 years ago and that is expected to reach 11 or 12 million by 1965.

The widening gap between supply and demand is only in part due to the decline in the size of college graduating classes since the peak of 434,000 in 1950. During the past 5 years the total number of graduates has declined 39 percent, but the number prepared to teach high-school physics has dropped 74 percent.

Although the pinch is most severe in physics, a similar situation prevails throughout science and mathematics; the supply of new high-school teachers has declined more rapidly than the total number of college graduates.

High-school principals, faced with an inadequate supply of science and mathematics teachers, have two courses of action open to them. They may use teachers who are inadequately prepared or they may drop courses that their students want and should have. Either action will mean that fewer students in the years ahead will enter college with a developing interest in science and mathematics.

Consequences of the Shortage

The shortage cannot help but affect unfavorably the rate of production of future scientists and the quality of their training; many students develop their interest in scientific careers at the high-school level. Also adversely affected will be the scientific knowledge and appreciation of the general public; many students are formally introduced to the sciences during their high-school years, and for a large number, high-school courses represent their only formal study of science.

The shortage of teachers of science and mathematics poses such serious consequences for scientific and technologic progress in the United States that an immediate, coordinated, large-scale attack on the underlying causes seems necessary. Since all branches of science will be affected, science as a whole has an important stake in the improvement of high-school teaching. The AAAS—first through the Cooperative Committee on the Teaching of Science and Mathematics and the Academy Conference (the composite organization of state and city academies of science), and then through the endorsement of the board of directors—has decided to do what it can toward improving the quality of science instruction and increasing the number of well-trained teachers. The program, *Science Teaching Improvement Program,* developed by the cooperative committee, will form the basic plan, and the Carnegie Corporation of New York has generously provided a grant of $300,000 to help finance these efforts. Additional funds will be necessary to carry out fully the proposed program.

Factors in the Current Situation

Of the factors responsible for the shortage of well-qualified teachers of science and mathematics and the deficiencies of much of the instruction given in these fields, four seem to be particularly important. Although some of these factors affect all high-school teachers, their combined effect has been greater on teachers of science and mathematics than it has on teachers of other subjects.

1) *Birth rate changes.* High-school enrollment is increasing and will continue to increase. The upsurge of births in the United States during World War II was followed by even higher birth rates in the postwar years; births in 1940 totaled a little more than 2 million; in 1954, 4 million. But the newly graduated teachers for the expanding high-school population must be drawn from the thin generation born during the 1930's when birth rates were low. Students currently graduating from college are wanted for many occupations other than teaching; the over-all shortage of new graduates affects teaching as well as other occupations.

2) *Lower salaries of teachers.* The salaries offered to high-school teachers are frequently lower than those offered to the same individuals by other prospective employers. Moreover, the salary increases and ultimate salary ceiling to which a teacher can look forward are lower than those in other professional fields.

3) *Educational policies and attitudes.* During recent decades the high school has changed from an educational institution designed chiefly to train a few students for college admission to one designed to give terminal training to large

The AAAS Cooperative Committee on the Teaching of Science and Mathematics includes one member for each of the following: American Association of Physics Teachers; American Astronomical Society; American Chemical Society; American Institute of Physics; American Nature Study Society; American Society for Engineering Education; American Society of Zoologists; Botanical Society of America; Central Association of Science and Mathematics Teachers; Division of Chemical Education of the American Chemical Society; Board of Directors of the AAAS; American Geological Institute; Mathematical Association of America; National Association of Biology Teachers; National Association for Research in Science Teaching; National Council of Teachers of Mathematics; National Science Teachers Association; Section Q (Education) of the AAAS; and (by invitation) the Academy Conference.

numbers of students who are not going to college. Although this change has brought many advantages, it has also made it more difficult for most high schools to give rigorous, high-quality courses in the subjects that are most appropriate as college-preparatory work. Consequently instruction in science and mathematics has suffered.

4) *Attitudes of scientists.* Although many scientists criticize the high school, and many college teachers of science deplore the preparation their students bring from high school, scientists have not, on the whole, accepted responsibility for the training of high-school teachers. This responsibility has been left largely to departments of education. College departments of science have not seen to it that prospective teachers had a good background in subject matter; they have not provided—as have education departments—summer-school courses for teachers; they have not encouraged their students to become science teachers; they have not made science teachers feel themselves to be part of the total scientific community. The many individual exceptions to these generalizations are encouraging, but still leave it true that scientists themselves must accept part of the responsibility for the shortage of science teachers and the inadequate preparation of many who are teaching science courses.

The AAAS clearly cannot rectify all the defects, but it can help. It has selected the following seven programs or types of effort, and it hopes to make useful contributions to each. Although these seven projects have been selected as desirable lines of effort, it is likely that future conditions and decisions will modify many of the details outlined here, and that they may produce major changes in the projects currently planned.

Responsibility of Scientists

High-school science teachers should have reasonable knowledge of the subjects they teach. There is room for debate over what constitutes "reasonable knowledge," but there seems little question that many individuals now teaching science in the high schools are inadequately prepared in the subject matter of science.

Educators generally believe that all high-school teachers should have a reasonable background in the field of teaching. Again there is room for debate over the proper amount; most states require between 18 and 30 semester-hours in such areas as student teaching, child psychology, teaching methods, and the history of education. Scientists are by no means unanimous, but many agree that such courses constitute desirable preparation for the prospective teacher.

State certification requirements and departments of education usually see to it that beginning teachers meet the formal requirements in education. Over the country as a whole there is no comparable insistence upon adequate subject-matter preparation as it is defined by scientists. It is in this area that we think scientists can and should accept greater responsibility and exert greater influence.

In the typical college or university science department, attention has been concentrated on the preparation of students for graduate work and research careers or on the preparation of students for engineering, medical, or other applied science areas. Students with an interest in high-school teaching and with the necessary aptitudes in science and mathematics either have not been encouraged to prepare for teaching or have been discouraged from making such preparation.

How many individuals who might have become satisfactory teachers of high-school science and mathematics have been lost to teaching in this way cannot be calculated. Whatever the past losses, if the situation is to improve, collegiate science departments must actively encourage qualified and interested students to prepare for careers in teaching, both high-school and college, but especially high-school. Accordingly, the AAAS plans an organized effort to bring the facts concerning the critical shortage of high-school teachers of science to the attention of college and university departments of science and mathematics and to urge their more active participation in the recruitment, training, and encouragement of high-school teachers of science and mathematics.

What is appropriate on one campus may not be appropriate on another. The following list, therefore, includes what appear to be desirable activities, but the details must be expected to differ from one institution to another.

1) Collegiate departments of science can examine, and frequently improve, their undergraduate courses and major requirements from the standpoint of their appropriateness for future high-school teachers.

2) Working with departments of education and state school officials, they can revise certification requirements to place greater stress on subject-matter preparation of prospective teachers.

3) They can develop courses suitable for high-school teachers who return to the campus for summer work. In many states a teacher with graduate work or a master's degree qualifies for a salary increase. The undergraduate work of many teachers who would like to get such increase is not adequate, however, for enrollment in the traditional graduate courses in science and mathematics. Turned away by departments of science, they concentrate in education, in which they can receive graduate credit. This situation creates a problem for science departments: they do not wish to water down their advanced courses; neither do they wish to give graduate credit for their elementary courses. Yet unless they make some adjustment, they are missing an opportunity to raise the level of high-school teaching and improve the preparation of future students in their own fields.

A number of colleges and universities are meeting this problem by developing special courses, usually offered in the summer term, that are open only to teachers. Thus these courses do not interfere with the usual sequence for students with other interests but are valuable for high-school science teachers. On some campuses these courses carry graduate credit in science; in others they are counted as education credit, even though they are planned and taught by science departments.

Other adjustments are also possible: a master's degree in science teaching can be given without interference with the usual master's degree in science. Efforts can be made to have school regulations amended to allow salary increases for appropriate additional college work, even though a good portion of the work is at the undergraduate level.

4) College and university departments of science and mathematics may assist high-school teachers in other ways, for example, by providing a departmental staff member to a neighboring high school to offer advanced instruction in science for a selected group of students. Sponsorship and support of meetings and conferences at which college and high-school teachers may exchange information is still another avenue through which college scientists can assist in improving high-school science teaching. Representatives of college and university staffs might also be made available for consultative and lecture services to high schools.

Emergency Measures

A large potential source of high-school teachers of science and mathematics consists of individuals who have had college work in these fields, who may be interested in teaching, but who lack the required courses in education. Such individuals are found among seniors in liberal arts, engineering, premedical, predental, and other curriculums; some of the students who started to specialize in these other fields later developed an interest in teaching, but made that change too late in their college careers to take the usual sequence of courses in education without unduly lengthening their college programs. Similarly, among col-

lege graduates with substantial amounts of work in the sciences and mathematics may be found some who would like to teach.

Special accelerated programs in education should be arranged for senior undergraduate students who wish to qualify for teaching positions before the beginning of the next academic year. For students in independent liberal arts colleges without departments of education, cooperative arrangements with departments of education in nearby institutions may need to be worked out. In any case, institutions of higher education should take the initiative in setting up such accelerated programs and in bringing them to the attention of interested students.

Many states provide for emergency teaching certificates that make it possible for a partially qualified individual to obtain immediate teaching employment and to satisfy the requirements for a standard teaching certificate while employed. In some cases accelerated programs in education leading to emergency certification may be possible; in others, especially those found among college graduates out of school for some years, supplementary or refresher work in science may be more appropriate. Colleges and universities, in cooperation with certification authorities, can take the initiative in establishing such programs and in bringing them to the attention of interested individuals in the regions that they serve.

The AAAS plans to study the effectiveness of tapping these resources of potential science and mathematics teachers, to collect information on what is already being done toward that end by individual institutions, and to hold a series of state conferences of scientists, educators, and state certifying officials to stimulate additional efforts toward the development of emergency programs for the training of science and mathematics teachers.

Recruitment for the Future

The efforts described in the preceding section are required to meet the pressing current shortage of science and mathematics teachers. To satisfy expanding requirements for the future, vigorous measures will be necessary to interest a considerably larger number of potentially qualified students in preparing for teaching careers.

Many steps may be taken toward the accomplishment of this objective. Among these are (i) the preparation and dissemination of appropriate guidance materials on mathematics and science teaching; (ii) the promotion of vocational guidance programs through assemblies, radio, and television; (iii) the utilization of scientists and engineers as counselors of students with scientific interests; and (iv) the encouragement of high-school science clubs, science fairs, and junior academies of science.

An important element in the development of a recruiting effort is knowledge of what it is that people find attractive and unattractive in the field for which one is recruiting. Some of these factors are already known insofar as they concern the field of teaching, but current and better information is desirable. Consequently the AAAS plans to make a study both of the factors that attract people into teaching, and of the factors that are important in influencing teachers to turn to other kinds of work. The information from the study can be used, not only in guidance and recruiting, but also, to some extent, in suggesting changes in school policies and arrangements that would make teaching more attractive.

Higher Salaries

At the root of much of the difficulty of attracting and retaining competent teachers are the prevailing low salary scales and the deterioration in the relative economic position of teachers with respect to other occupational groups. Although all teachers are affected by these economic factors, the problem arises most acutely in the recruitment and retention of science and mathematics teachers. Industry and government compete more aggressively for persons with training in science and mathematics than they do for prospective teachers in other fields.

We support the principle that beginning salaries, rates of salary advance, and salary ceilings for teachers should be comparable to those available to other professional personnel of equivalent training. Obviously the AAAS cannot bring about such a sweeping change; this can be accomplished only by widespread local action at the community level. What the AAAS can do is to enlist the aid of state academies of science and other state and local scientific groups in bringing to clearer public attention the need for higher salaries for teachers and the special problems that exist in the fields of science and mathematics. Moreover, its 50,000 members and the members of its 260 affiliated and associated societies could lend their influence to these efforts in their own communities.

The salaries of teachers of science and mathematics are usually controlled by general salary schedules. It is doubtful that salaries of science and mathematics teachers could be raised above general levels, and debatable whether they should be. Efforts to increase the total income of science teachers are, however, being made by methods other than salary increases. Therefore a study is also contemplated of the various ways in which science teaching can be made more attractive financially by such devices as year-round employment, summer employment in science-related industries, or additional pay for directing student research projects, science clubs, science fairs, and other activities. Most salary schedules at present do not provide for increases on a merit basis. Although it is recognized that such differential scales are debatable, consideration of this problem by scientists might lead to a more satisfactory solution.

Better Working Conditions

To a considerable extent, the large size of classes, heavy teaching loads, and lack of adequate laboratory facilities and instructional equipment discourage competent students of science and mathematics from looking forward to careers as teachers. These same factors contribute to the high rate at which teachers of science and mathematics leave teaching for other occupational fields.

The AAAS, both as an association and through its individual members, can bring to the attention of appropriate groups the need for improving the conditions under which science teachers work. It will investigate the effectiveness of the use of teaching assistants and of such instructional aids as motion pictures, radio, and television in increasing teaching efficiency and providing the teacher with more attractive working conditions. It will give special attention to the adjustment of teaching load, so that a more effective job may be done, particularly in connection with laboratory instruction.

Believing that closer affiliation with organized science and the resultant enhancement of professional *esprit* would benefit teachers, the AAAS plans to encourage the attendance of teachers at scientific meetings and will support the provision of time off and reimbursement of travel expenses to encourage such attendance.

Awards for Distinguished Teachers

In recent years the secondary-school teacher has not enjoyed high prestige, not by any means, we think, as high as his contribution to society merits. The public recognition of exceptionally able teachers of science and mathematics represents one means of enhancing their prestige. The AAAS therefore plans to institute an annual program of awards to outstanding teachers. The teachers to be honored will be those who, over a period of years, have been recognized in their schools and communities as exceptionally effective, whose knowledge of

science or mathematics approximates that of the master's degree level, and who have, through writing or other means, been of substantial help to their fellow-teachers. Such teachers are good "professionals" and merit higher prestige than is accorded to teachers generally. We propose to honor them with citations as Distinguished Service Teachers. Since these citations are intended not only to reward excellence but also to call public attention to the importance of good teaching, the citations will be awarded in the teachers' own schools.

If financial backing can be secured, even more might be done. For example, the teachers selected for citation might be given monetary awards; or the expenses might be underwritten for each year's group to attend the annual meeting of the AAAS.

The scope of these plans is flexible. The number selected each year should be small enough to make the citation a real honor, yet large enough to make the motivation and prestige values as widely effective as possible. Perhaps 100 Distinguished Service Teachers a year would be a good starting level.

Intelligently administered, rank and honors are not only an award to those who receive them but an inspiration to those who aspire to them. For many individuals, and particularly those who are sincerely attracted by the opportunity to guide the intellectual development of young people, the respect accorded the teacher may provide the best measure of the value that society places on teaching.

Consultants to Teachers

The plans described here are designed to retain experienced science teachers in the classroom and to increase the number of young people who prepare to teach science. Even if these goals are achieved, the greatly increased high-school enrollment of the next few years will in all probability necessitate the use of many science teachers with less than adequate preparation. It is proposed, therefore, to undertake a pilot study of a method for "upgrading" the work of relatively inexperienced and inadequately prepared teachers.

The plan provides for the employment in each of several geographic regions of two competent science or mathematics teaching counselors—expert consultants—who will tutor, assist, and serve as a source of information and help to the less-experienced and less-competent science teachers of the region. These consultant teachers would have no administrative supervision over their colleagues and would be employed only in regions in which supervisory help in science and mathematics is not already available within the school system.

If one such consultant were made available to each group of 20 to 25 teachers, the increase in staff would amount to only 4 or 5 percent. The number of teachers will increase anyway; perhaps this type of increase would be more effective than others. It seems worth while to test the hypothesis that the total effectiveness of instruction will be greater with such consultants than if the same individuals simply taught classes all day.

If this hypothesis is borne out, it is hoped that the demonstration will encourage school systems, state departments of education, and colleges and universities to assume permanent responsibility for providing continuing consultant services in science and mathematics to nearby high-school teachers of those subjects.

Role of the AAAS

It should be obvious that the AAAS can work more effectively on some of the foregoing proposals than it can on others. On the one hand, the AAAS has strategic opportunity to work toward the assumption on the part of scientists of greater responsibility for the training of science teachers. On the other hand, there is nothing unique that the AAAS can do on the problem of raising teachers' salaries.

There are so many facets to the problem of bringing about a sizable increase in the supply of well-prepared high-school teachers of science and mathematics, and of improving high-school teaching in these fields, that the AAAS cannot hope to achieve any large measure of success without the concurrent efforts of many other groups and organizations. Although it will supplement and sometimes cooperate with other programs looking toward the same ends, the AAAS will concentrate its major effort on the projects that it is particularly well qualified to carry out by virtue of its broad representation of scientists and science teachers in all the sciences at all levels.

Biological Effect of Atomic Bomb Gamma Radiation

Eugene P. Cronkite, Victor P. Bond, W. H. Chapman, R. H. Lee

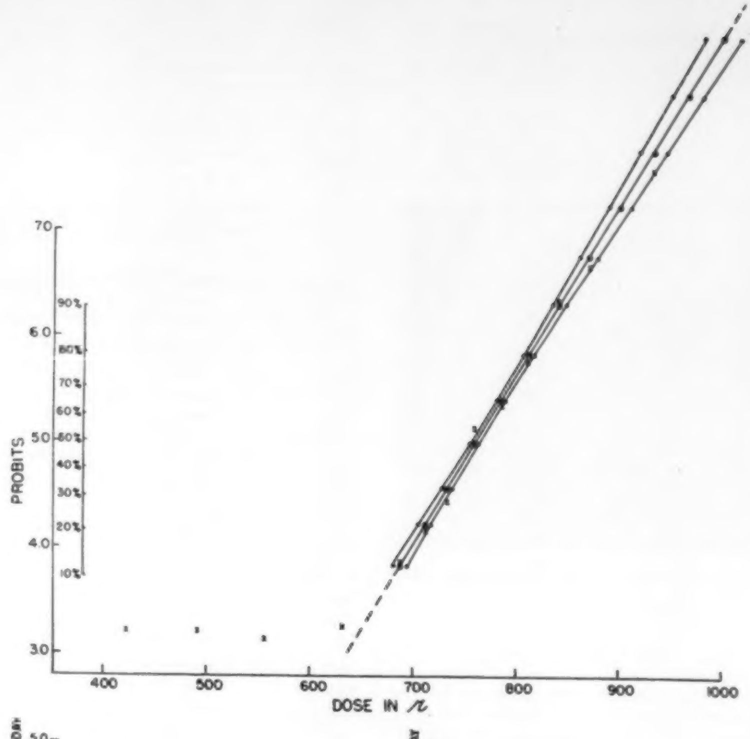
The gamma radiation from the atomic bomb has been appropriately divided into the prompt gamma radiation associated with the fission process and the delayed gamma radiation. The delayed gamma radiation has been subdivided into the initial gamma radiation that extends through the first minute after detonation and the gamma radiation that is associated with contamination by fission products. With the air-burst, the latter is unimportant. The prompt gamma rays are of relatively little importance, because they are filtered out by the materials surrounding the bomb (*1*).

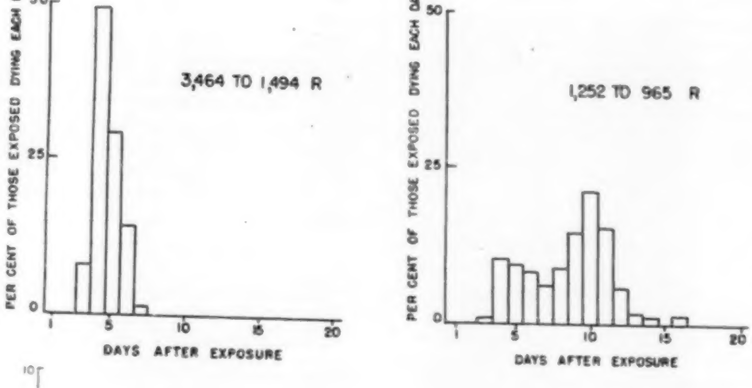
The high dose rate and the reported high effective energy of the initial gamma radiation had led to speculation about the relative biological effect (RBE) of this nuclear radiation as compared with the usual laboratory x-rays and gamma rays. Estimates of the relative biological effect by various competent individuals varied considerably, and a value of 1.0 was considered unlikely. The relative effect and species differences in effect of radiations on mortality was studied extensively by Boche and Bishop (*2*).

Field determination of the gamma-ray relative biological effect, using mortality in mice as the criterion, was undertaken by the Naval Medical Research Institute, Bethesda, Md., and the Naval Radiological Defense Laboratory, San Francisco, Calif.; extensive control studies of x-ray mortality on mice were conducted, both in the United States and at the Pacific Proving Ground (*3*).

The control studies consisted of exposing first-generation hybrid LAf_1 mice to laboratory sources of x-rays of several energies and with different conditions of scatter. Approximately 10,000 mice were exposed in various control studies (*4*).

Commander Cronkite, Lieutenant Chapman, and Commander Lee were stationed at the Naval Medical Research Institute, Bethesda, Md. Lieutenant Bond was at the U.S. Naval Radiological Defense Laboratory, San Francisco, Calif. Dr. Bond and Dr. Cronkite are now at Brookhaven National Laboratory, Upton, L.I., N.Y.





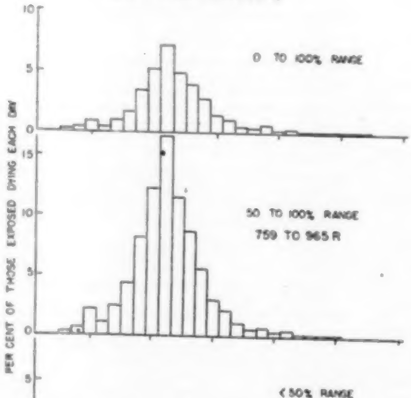


Fig. 1 (top). Probit regression line of mortality as a function of arithmetic dose: *x* observed mortality; • regression line with 95-percent fiducial limits. Note low constant mortality below 650 r. Fig. 2 (center). Pattern of deaths in the supralethal range. Above 1500 r unimodal; below 1500 r bimodal. Fig. 3 (bottom). Pattern of deaths within the lethal range. Above 50-percent mortality, a trend toward bimodality is seen. Below 50-percent mortality, bimodality is absent and pattern tends to be rectilinear.

A total of 4720 mice were selected and randomized for exposure to the gamma-ray spectrum from a nuclear detonation. Detailed selection and randomization with respect to sex, age, and weight were carried out in order to insure data of maximum statistical significance. Multiple estimates of dose were obtained with physical and biological dosimeters placed at the same location as the mice—for example, *Tradescantia*, film packs, and additional mice for splenic and thymic weight changes.

The mice were exposed in cylindrical aluminum containers designed to protect the animals from blast, thermal radiation, and radioactive dust. A total of 28 stations were disposed on both sides of the estimated LD_{50} distance. At these distances the initial gamma radiation from the device has attained equilibrium conditions with the atmosphere.

In Fig. 1 the probit regression line of mortality as a function of roentgens in air, as determined by the Sievert ionization chambers, is given. The estimated LD_{50} was 759 r. The best fit for this regression line was obtained with arithmetic dose rather than log dose (*4*). The excellence of the fit for linear regression above 10-percent mortality is seen. From 190 r, the lowest dose to which animals were exposed in the field, to approximately 620 r, there was a constant mortality of about 3 percent. That this mortality was caused by irradiation is supported strongly by the fact that there was no mortality for the observation period in 640 control mice that were submitted to the same environment. The absolute lethal dose is in the vicinity of 950 r.

A qualitative comparison of the bomb data with that using x-radiation at a potential of 250 kvp showed no differences with respect to signs of illness, mean survival time, or pattern of survival time. The pattern of daily deaths as a function of time after exposure varied with the dose. In Fig. 2 the supralethal pattern is shown. Above 1250 r, the distribution of deaths is clearly unimodal, with deaths occurring between the third and seventh days. Between 950 and 1250 r, the distribution of deaths is clearly bimodal, with peaks occurring on the fourth and tenth days after exposure. In Fig. 3 the pattern of deaths within the lethal zone is given. The first peak of deaths is small and occurs only in the 50- to 100-percent-lethal range. Below the LD_{50} no distinct peak was obtained. Figure 4 is a tridimensional graph of the daily deaths as a function of dose and of time after exposure.

The first peak of deaths has been well correlated with irreversible gastrointestinal injury; and the second peak, with the sequellae of pancytopenia (anemia, infection, and hemorrhage) (*5*).

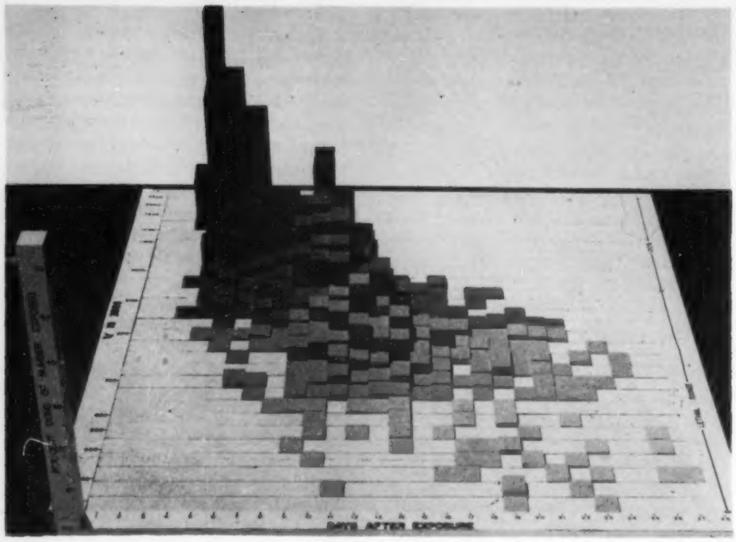


Fig. 4. Tridimensional graph of daily deaths as a function of dose and of time after exposure.

To determine quantitatively the relative biological effect of any toxic agent, it is essential to determine that the biological and physical factors are identical in every respect, except the factors in question—in this case, the dose rate and the energy. The dose-rate problem was approached experimentally in the laboratory, and no significant difference between 15 and 2500 r/min could be ascertained. The latter dose rate is an approximation of the mean dose rate delivered by the bomb within the lethal range.

Two remaining problems were (i) selection of control data that were biologically comparable to the bomb data and (ii) selection of physical measurements for both the bomb and the control data that best indicated the energy absorbed by the mice. To select control data that were biologically comparable, it was necessary to consider the properties of the statistical methods used for anaylsis. The relative biological effect was based on the comparison of linear regression lines determined by probit analysis. The equation for the linear regression line is $y = a + bx$, where y is the percentage of mortality expressed as probits, and x is the arithmetic dose. When the best linear regression is obtained with arithmetic dose (instead of log dose) the method of comparison is as follows.

If paired experiments are performed in which the apparent doses differ by a constant factor because of relative effect such that x is modified by c and all other factors are constant, then the equations are connected in the following manner:

$$y = a + bx = a + b\ (cx)$$

showing that the intercept a is characteristic of the drug or radiation employed, while the slope bc contains the relative effect factor. The determination of the relative biological effect demands then that the intercept a of the experimental and control regression lines be not significantly different. Calculation of the relative biological effect therefore becomes the direct ratio of the slopes or the inverse ratios of the LD_{50}'s.

Data existed where the intercept a for the bomb and x-ray control data were essentially the same, but the determination of the proper numerical values to be used for the respective LD_{50}'s remained.

From the work of Ellinger (*6*) and from the extensive control data, it was apparent that scattered x-rays, as well as the primary beam, were important with respect to the mortality of mice. From the control data, it appeared that scatter was not completely additive. The greater the degree of scatter, the lower the LD_{50}'s, suggesting that scatter was more effective than the primary beam. However, in the absence of a precise method to determine the relative effect of the scatter, scatter was merely added to the air dose in obtaining the proper or the best value of the LD_{50}.

When considering the scatter of the primary beam, and the study in which the intercept a was most comparable to the intercept a for the bomb data, a value of 650 r for the control x-ray LD_{50} was obtained.

From the physical measurements of radiation that were made in and outside the exposure apparatus, and from direct measurement and calculations of the influence of the exposure apparatus on the air dose, it was determined that the best approximation of the LD_{50} for the bomb radiation was 680 r; thus giving

$$\text{RBE} = \frac{(LD_{50})\text{x-ray}}{(LD_{50})\text{bomb}} = \frac{650}{680} = 0.96$$

If one compares all the sets of data neglecting the intercepts, the widest range in the relative biological effect is 0.9 to 1.1. One can therefore conclude that the relative biological effect (using mouse mortality as an end-point) of the initial radiation from a nuclear device is essentially unity. For animals of increasing size, depth dose considerations may alter the apparent relative biological effect.

It should be noted that the relative biological effect obtained in these studies was higher than the values reported for high-energy gamma radiation under conditions of exposure in the laboratory (*4, 7*). The present conditions of exposure differed from those in the laboratory in that, at the distances from the bomb used, the gamma-ray beam was in equilibrium and a sizable component was present with energy less than 200 kev (*8*). Hence, even though the source energy was high, the energy of photons of the degraded beam delivering a large part of the dose to the animals was comparable to that obtained with x-rays at a potential of 250 kvp. Thus, a relative biological effect of approximately 1 would not be unexpected under the circumstances.

References and Notes

1. Details of the energy and dose rate of the atomic bomb gamma radiation can be found in the handbook on atomic weapons published by the Government Printing Office, 1951. The established terminology is somewhat confusing. What is called initial radiation is in reality the mixed gamma from early fission products and neutron reactions with the atmosphere and components of the device.
2. R. D. Boche and F. W. Bishop, in *Biological Effects of External Radiation*, H. A. Blair, Ed. (McGraw-Hill, New York, 1954), Chap. 1.
3. This work was performed at the U.S. Atomic Energy Pacific Proving Ground in 1951; publication was delayed owing to delay in official clearance.
4. A best fit with arithmetic, rather than log, dose for mouse x-ray mortality has been reported on by Cornfield in data obtained in control studies for this fieldwork. The full statistical analysis of data is contained in E. P. Cronkite *et al.*, "Relative biological effectiveness of atomic bomb gamma radiation." NM 006-012.04.86 Naval Medical Research Institute, Bethesda, Md., in preparation.
5. V. P. Bond, M. Silverman, E. P. Cronkite, *Radiation Research* 1, 389 (1954).
6. F. Ellinger, *Radiology* 44, 125 (1945).
7. J. T. Brennan *et al.*, *Nucleonics* 12, 31, 48 (1954).
8. L. D. Gates, Jr., and C. Eisenhauer, "Special distribution of gamma rays propagated in air," *Tech. Anal. Rept.* AFSWP No. 502A, January 1954.

News of Science

Director Named for AAAS Science Teaching Improvement Program

The announcement that John Mayor has agreed to be the first director of the AAAS Science Teaching Improvement Program is very welcome news. The program to increase the number of well-qualified science and mathematics teachers is the culmination of the work of many groups, centering in that of the Cooperative Committee on the Teaching of Science and Mathematics. This committee has been in existence since 1941 and, since the close of World War II has been chaired by Karl Lark-Horovitz of the department of physics, Purdue University; Morris Meister, principal of the Bronx High School of Science; and John Mayor of the departments of mathematics and education, University of Wisconsin.

To carry out the program described at the beginning of this issue entails the cooperation of many persons, but it also depends upon some one person to see that it goes forward on all fronts, to coordinate the efforts of others, and to give administrative direction to the whole. As is the case for every important post, this person should have intelligence, vigor, and character, but for this particular position he also must be both a scientist and a person who has had intimate association with secondary education. Mayor, to a remarkable degree, satisfies these conditions.

Mayor is now 49 years old. He received his bachelor's degree from Knox College, his master's degree from the University of Illinois, and in 1933 his Ph.D. in mathematics from the University of Wisconsin; his field of specialization is geometry. During his graduate work at Wisconsin, he taught as a graduate assistant and after receiving his doctorate, continued at the university and its Milwaukee Extension Division until 1935, when he became chairman of the department of mathematics at Southern Illinois University. He returned to Wisconsin in 1947 as associate professor of mathematics and education in charge of the training of mathematics teachers. He was promoted to professor in 1951, again in both the department of mathematics and the department of education; he also served as chairman of the department of education. During 1954–55 he has been acting as dean of the School of Education, still retaining his professorship in mathematics. His teaching program has included courses in pure mathematics, courses in the teaching of mathematics for high-school teachers, and direction of the program of mathematics in the Wisconsin High School where he supervised practice teaching in the field of mathematics.

By nature Mayor is a gifted teacher; yet he has always shown, both by example and precept, that even the exceptionally able teacher can improve through deepening his knowledge of his subject and studying the methods for presenting it—illustrating the fact that a man reaches excellence only through a combination of talent and education.

He has written many articles, some of them research papers in mathematics, some mathematical exposition, and still others concerned with the teaching of mathematics. Mayor has a capacity for hard work and an enthusiasm that makes him enjoy it. This enthusiasm is not so much an ebullience of spirit as a keen desire to help attain goals that he believes are important. This not only has made him an outstanding success as a teacher at the university but has led him to serve on many committees for the improvement of scientific and mathematical education, to serve as officer of professional societies, including the presidency of the National Council of Teachers of Mathematics, to speak before state and local groups throughout the country, to serve as chairman of the Cooperative Committee, and now to be charged with carrying its program forward. I know of no one who would be more likely to carry such a program forward with vigor or to secure from others the cooperation necessary to its success.

MARK H. INGRAHAM

College of Letters and Science, University of Wisconsin, Madison

Do Ruminants Sleep?

The behavior of cattle and sheep has been carefully studied by a number of workers in recent years, and the evidence strongly indicates that these ruminants do not normally lose consciousness during either day or night. During digestion experiments with cattle, C. C. Balch [*Nature* **175**, 940 (1955)] observed that the animals never appeared to sleep and always used the same lying position. Throughout the night, periods of lying resting are interspersed with periods of standing and of rumination. Therefore, if sleep occurs at all in cattle, it must be of the polyphasic type. As a result of his studies, Balch concludes that, under normal conditions of management, healthy adult cattle and sheep, and probably ruminants in general, sleep little, if at all. He suggests that this ruminant peculiarity may be related to the need for upright maintenance of the thorax in proper functioning of the reticulorumen and to the requirement of time and consciousness for rumination.—W.L.S., JR.

Marine Chemistry

In 1953 our fishing industry found itself in an increasingly difficult position. Rising imports, decreased landings, depletion of fishing grounds, lack of modern techniques, and consumer indifference to American products, placed our fishermen in an unfavorable competitive position. In May 1954, Senator Leverett Saltonstall and Senator John F. Kennedy introduced a bill that provided that an amount equal to 30 percent of the gross receipts from duties collected under the customs laws on fishery products should be used to promote our domestic fisheries through biological, technologic, or other research pertaining to American fisheries. This bill, which also provided for the establishment of a Fisheries Advisory Committee, became Public Law 466, approved 1 July 1954.

The passage of the Saltonstall-Kennedy Act gave recognition to the importance of our marine resources and emphasized the significance of scientific

research in maintaining a prosperous fishing industry. It added an amount not to exceed $3 million to the $3.5 million annual budget of the Fish and Wildlife Service of the U.S. Department of the Interior, and thus enabled this Government office, through its own scientific research staff or through contract work carried out by universities or research institutions, to attack many vital problems that previously could not be investigated adequately, if at all. Although the work of the Fish and Wildlife Service covers many aspects of basic and applied research, it is noteworthy that the application of chemical and biochemical methods is dominating in the search for more efficient handling and processing methods and improved quality of fishery products.

The trawler *Delaware* of the Fish and Wildlife Service is carrying out research work in the North Atlantic to find the best way of freezing fish in the round and storing frozen fish in the hold. One promising method is to immerse freshly caught fish in a sodium chloride brine of 10°F. Low temperatures can now be easily obtained by using Dry Ice and alcohol, which make an excellent cooling medium. Additions to the brine such as antioxidants, glucose, and sucrose are being tested for their capacity to improve the flavor and appearance of the product and to counteract undesirable effects of sharp freezing and long storage.

The expanding market for frozen packaged foods is a remarkable recent development in the American food industry. In this field, packaged frozen fish products are playing an important role, and this, in turn, necessitates an ample supply of suitable raw fish. There is no need to rely so heavily on foreign sources for the supply if our domestic fishing industry is properly equipped with adequate fishing gear and freezing methods to venture from the depleted fishing grounds off the shore to better, more distant grounds.

Equal in importance to the fresh or processed fish and shellfish products are the fishery products that enter into animal feedstuffs and pharmaceutical and industrial products, in the processing of which chemistry is to play an ever more important role. The exceptional value of fish meal and concentrated fish solubles as a source of protein of highest biological value, of vitamins, and of the not yet completely understood "growth factors," is now so universally recognized that they are widely used as feed supplement in animal and especially in poultry feeding. Small amounts of fish oil greatly improve the palatability and the nutrient value of poultry fodder, prevent dustiness, and preserve the carotene and vitamin-A content by acting as link between vitamin or provitamin on the one hand and natural antioxidants on the other. Unfortunately, the amount of fish oil that can safely be added to poultry fodder without causing off flavors in poults and eggs is very limited, being 3 percent at most.

Although fish meal and fish solubles are much in demand, fish oils, which once constituted the main product of the fish reducing industry, face heavy competition from animal and vegetable fats and oils. Moreover, the market is shrinking, owing to the partial replacement of soaps by synthetic detergents, and the use of synthetic resins in paints. In order to secure for the fish reducing industry a healthy economic basis, chemistry is again called upon to develop processing and utilization methods that will bring out the unique chemical properties of fish oils, thus giving them a competitive advantage over other fats and oils.

Considering the structure of the unsaturated fatty acids of fish oils, it is easy to see how splendidly they could lend themselves as starting points for numerous organic products, inasmuch as the dicarboxylic fatty acids obtained through their oxidative splitting are just the ones most in demand for synthetic plastics and fibers. Unfortunately, the hydrolysis of fish oil gives only a mixture of fatty acids that requires costly and uneconomic steps for separation into its constituents. However, recent methods of separation by way of cathrates (addition crystals of fatty acids with urea or thiurea) offer new and promising avenues of chemical utilization of fish oil that are now being intensively investigated.

The Fisheries Advisory Committee, which was created under the Saltonstall-Kennedy Act, held its first session 28–29 Apr. The committee recommended the following criteria for consideration of projects under this Act: degree of emergency; national, or more than purely local, scope; extent of large-scale capital investment; substantiality in value, volume, and employment; extent to which fishery is affected by imports; extent to which results can be obtained in a reasonable time; relative need to fill gaps in knowledge; degree to which industry or states could do the work; relative need for the work and prospects for successful achievement; relationship of costs to benefits; effect on balance among major categories of work.

Some of the major projects already undertaken under the Act are (i) studies to determine racial characteristics of salmon on the high seas; (ii) research on fluctuation of the California sardine; (iii) study of causes and control of toxic red tide off the Florida coast; (iv) development of voluntary Federal grades and standards for fishery products; (v) development of chemical index and nutritive value of fish meal and development of new uses for fish oils; (vi) exploration of deep-water fishing grounds in the North Atlantic.

Since its passage, the Saltonstall-Kennedy Act has already proved its great value for the fishing industry, even though only a small part of the problems could be attacked in such short time. The utilization of the enormous salmon waste and the shrimp heads of the rapidly expanding shrimp industry, the enzymatic digestion of fish offal, the manufacture of fish flour and fish sausages, and a better utilization of the sponges and aquatic plants, especially seaweeds, off our shores, offer a large field of research, and promise technologic developments that could bring prosperity to our fishing industry.

FRANCIS JOSEPH WEISS
2000 37th Street, NW, Washington, D.C.

■ At least in Japan there appears to be a striking elimination of children of blood groups A and B because of a fetal incompatibility between them and their mothers when the latter are of group O. Ei Matsunaga [*Am. J. Human Genet.* 7, 66 (1955)] estimates the deficiency of A children to be about 14 percent of all expected from the mating of O mothers by A fathers; and the deficiency of B children from the mating of O mothers by B fathers is about 10 percent. Miscarriages were significantly higher in these matings than in the converse types. There is evidence that, as a consequence of this strong selection, blood groups A and B are diminishing in frequency among the Japanese.—B. G.

■ The House of Delegates of the American Medical Association at its June meeting in Atlantic City passed three resolutions concerning the introduction of new methods in the treatment or prevention of disease and concerning the Salk poliomyelitis vaccine. The first resolution reaffirmed "confidence in the established methods of announcing new and possibly beneficial methods in the treatment and prevention of disease" and reaffirmed "the need for the presentation of reports on medical research before established scientific groups, allowing free discussion and criticism, and the publication of such reports, including methods employed and data acquired on which the results and conclusions are based on recognized scientific publications." The second resolution criticized possible government control of vaccine, disapproving "the purchase and distribution of the Salk poliomyelitis vaccine by any agency of the Federal Government, except for those unable to procure it for themselves and that such necessary federal funds therefore be allocated to the various proper state agencies for such purposes," and urging the Congress of the United States

to "allow the Salk poliomyelitis vaccine to be produced, distributed, and administered in accordance with past procedures on any new drug or vaccine." The third resolution commended Salk, expressing "profound gratitude" to him and "admiration for his monumental contribution to medical science."—E. M. L.

Scientists in the News

The Foreign Operations Administration has appointed E. E. LEUALLEN, dean of Columbia University College of Pharmacy, to serve 3 mo in Formosa as a consultant in pharmacy. He will study local needs and aid in developing a program for the newly established School of Pharmacy at the National University of Taiwan.

AUSTIN L. RAND, curator of birds at the Chicago Natural History Museum since 1947, has been appointed chief curator of the department of zoology to succeed Karl P. Schmidt, who retired 1 July. Rand was previously associated with the American Museum of Natural History, New York, and the National Museum of Canada, Ottawa. He has conducted zoological expeditions in Madagascar, the southwest Pacific, the United States, Canada, and Central America.

EMMET R. BLAKE succeeds Rand as curator of birds. Blake, who had led expeditions to the West Indies and to Central and South America for the Carnegie Museum of Pittsburgh and the National Geographic Society, first joined the museum staff in 1935 as assistant curator of birds, and since 1947 has been associate curator of birds.

CLAY WAGGONER, head of the analytic section of the research department at American Potash and Chemical Corp., Trona, Calif., has been appointed chief chemist at the new San Antonio, Tex., plant of American Lithium Chemicals, Inc.

ERNEST W. GOODPASTURE, former professor of pathology and acting dean of the School of Medicine, Vanderbilt University, has been appointed scientific director of the department of pathology of the Armed Forces Institute of Pathology. He will be responsible for the supervision and correlation of the professional functions of the department, which include diagnostic consultative services in pathology, an advanced teaching program, and experimental studies in pathology and the ancillary sciences.

JOHN K. MAJOR, of Yale University, has been appointed associate professor and chairman of the department of physics at Western Reserve University.

BRYAN PATTERSON, former curator of fossil mammals at the Chicago Natural History Museum, has been appointed Alexander Agassiz professor of vertebrate paleontology at Harvard University.

ALFRED O. WOODFORD, chairman of the geology department at Pomona College, retired in June. Woodford received training at Pomona and the University of California at Berkeley. His fields of special study have included the rocks and minerals of Southern California and Lower California, stream hydraulics, submarine canyons, and the history of geology. In recent years he has directed the geology department's research on the surface and subsurface region between Claremont and Laguna Beach. He has also studied the structure of margins of the San Gabriel Mountains and has worked closely with the U.S. Geological Survey, for which he has been a senior geologist since 1943.

Woodford was author of the report on the National Science Foundation's conference on geological research in colleges in 1953. He was in charge of the Southern California section for the National Research Council in preparation of a tectonic map of the United States, a nine-year project that was completed during World War II.

JOHN H. DINGLE, professor of preventive medicine at Western Reserve University School of Medicine, was elected president of the Armed Forces Epidemiological Board on 1 July. He succeeds Colin M. MacLeod, of New York University School of Medicine. Robert W. Babione, Capt. MC, USN, became executive secretary of the board on the same date.

CLIFFORD W. DUNCAN, professor of agricultural chemistry at Michigan State University, received the Borden award—$1000 and a gold medal—during the American Dairy Science Association meeting in East Lansing in June.

Duncan was cited for research accomplishments pertaining to the biochemical and physiological character of the protein and other constituents of blood, milk, and semen of the bovine; investigations related to the vitamin and mineral requirements, especially the trace minerals of the cow and calf; the composition, digestibility and nutritional value of feeds; and the nutritional effects of crops grown on soils of different fertility level on the health, production, and reproduction of dairy cows.

JAMES G. WILSON, professor of anatomy at the University of Cincinnati, has been appointed to head the anatomy department of the University of Florida's College of Medicine, effective 1 Sept.

JOHN S. RUGG and GEORGE W. SCOTT, chemists of E. I. du Pont de Nemours and Co., Inc., Wilmington, Del., were the winners of a new award of the American Chemical Society's Division of Rubber Chemistry. The award is for the best scientific paper presented before the division at its 3-day spring meeting in Detroit in May.

Rugg and Scott were cited for the technical importance of their paper and for the high quality of the oral and visual presentation. The report, which was entitled " 'Adiprene' B urethane rubber—factors influencing its processibility," described methods for processing the tough, temperature-resistant new synthetic.

The Eli Lilly Co. has announced several recent staff changes. THOMAS P. CARNEY has been elected vice president of research, development, and control. Succeeding him as director of the organic chemical division is REUBEN G. JONES, former head of the company's general organic chemistry division. A. H. FISKE, vice president and member of the executive committee, will relinquish his responsibilities in the development and control division in order to devote full time to the study of special projects as an assistant to the president. R. M. RICE has become executive diector of medical research, and J. A. LEIGHTY executive director of chemical, biological, and pharmacological research.

PORTER H. BRACE, consulting metallurgist to the Westinghouse Research Laboratories, has retired after 42 years of service. His work has been concerned with rare-metals technology and the production of versatile metal alloys.

He has studied specialized melting techniques such as cage zone refining, a technique that is becoming increasingly important in obtaining almost totally pure metals, for example, titanium. About 1920 he devised the Brace process for the production of pure calcium. This process subsequently became a factor in the mass production of uranium.

JOHN CHIPMAN, professor of metallurgy and head of the department at Massachusetts Institute of Technology, was presented the Brinell gold medal for 1954 in a ceremony at the Swedish Academy of Engineering Sciences in Stockholm on 25 May. He was awarded the medal by the academy "in recognition of his outstanding achievements in metallurgy and metallography." This is the first time that a non-Swedish scientist has received the award, which was instituted in commemoration of J. A. Brinell, inventor of the Brinell test. Chipman gave a lecture on metallurgical research activities being carried on at M.I.T.

ALBERT J. HOSKINSON, chief of the geodesy division of the U.S. Coast and Geodetic Survey since 1952, retired 1 July. He was trained in civil engineering at the University of California and joined the Coast and Geodetic Survey in 1921. Hoskinson devoted the early part of his career to geodetic and hydrographic assignments in Alaska, the Philippines, and various areas of the United States. In 1936 he was one of three geophysicists who used the Vening-Meinesz pendulum apparatus with the United States Navy-American Geophysical Union Gravity-at-Sea Expedition aboard the submarine *Baracuda* in the West Indies.

Hoskinson has made several improvements in methods and techniques for making gravity observations. Among these are the development of a method of setting up the Brown gravity instrument at CGS field stations to minimize the variations in the flexure; a method of observing and recording that shortened the time of swing required at a gravity station from 12 to 6 hr; and a determination of the effects of buoyancy and damping of the pendulum at extremely low pressures.

Hoskinson served in the Army during both world wars. During World War II he served as an artillery survey supervisor and chief instructor at Fort Sill, Okla.

In 1952 he was a member of the United States delegation to the sixth consultation of the Commission on Cartography, Pan American Institute of Geography and History, which was held at Ciudad Trujillo, Dominican Republic. During September 1954 he served as delegate to the 10th general assembly of the International Union of Geodesy and Geophysics in Rome, Italy.

JULIUS L. WILSON, professor of medicine at the University of Pennsylvania and director of clinics at the university's Henry Phipps Institute for the Study, Treatment and Prevention of Tuberculosis, has been appointed director of the Phipps Institute. He succeeds ESMOND R. LONG, who retired 30 June after having headed the institute since 1935.

STEPHEN ROTHMAN, professor of dermatology at the University of Chicago, has received the special award for 1955 of the Society of Cosmetic Chemists.

FRED W. SCHUELER, professor of pharmacology at the State University of Iowa, has been awarded the Ebert prize of the American Pharmaceutical Association "for his basic research on pharmaceutical inhibiting agents and compounds which may lead to new and useful drugs for combatting and controlling severe high blood pressure."

WERNER KARL WEIHE, former head of the electrotechnical laboratory of the Karl Zeiss Co., Jena, Germany, who is now serving with the Corps of Engineers at Fort Belvoir, Va., was admitted to United States citizenship 2 July.

ARTHUR W. GALSTON, of California Institute of Technology, was appointed professor of plant physiology at Yale University, effective 1 July.

HENRIK DOUWE KLOOSTERMAN of the University of Michigan has been appointed Netherlands visiting professor of mathematics for 1955–56. He is serving on the faculty of the University of Leyden as professor of mathematical analysis.

Necrology

J. WESLEY ANDERS, Philadelphia, 89, former professor of diseases of the ear, nose and throat at Temple University School of Medicine, 17 June; EDWARD M. BERNECKER, New York, 63, hospital administrator of New York University–Bellevue Medical Center, former commissioner of hospitals in New York, 27 June; PETER J. CONROY, Crestwood, N.Y., 60, head of the department of chemistry at Fordham University College of Pharmacy, 17 June; CLYDE L. EVERSON, University Park, Md., 49, professor of veterinary science at the University of Maryland and former president of the Maryland Veterinary Medical Association, 6 July.

EDWARD P. FENIMORE, Philadelphia, former assistant professor of chemical engineering at the University of Pennsylvania, 23 June; FRANKLIN FISKE, New York, 75, osteopath, lecturer, former editor of the *Journal of Osteopathy*, 22 June; ALEXANDROVICH GAMBURTSEV, Moscow, 52, director of the Geophysical Institute of the Academy of Sciences, chairman of the academy's council on seismology, 28 June.

GEORGE HARTNELL, Wyoming, N.Y., 84, former research geologist with the U.S. Coast and Geodetic Survey, author, 20 May; DAVID W. HEUSINKVELD, Cincinnati, 57, assistant clinical professor of medicine at the University of Cincinnati, 25 June.

S. DAVID KRAMER, St. Petersburg, Fla., 63, former instructor at the Harvard and University of Michigan Medical Schools, former director of research of the Infantile Paralysis Commission of the Long Island Medical College, author, 24 June; PEYTON B. LOCKER, Bronxville, N.Y., 82, mineralogist, director of the American International Minerals Corp., 3 July.

EDGAR G. MILLER, JR., New York, 62, dean of graduate faculties at Columbia University, former professor of biochemistry at the university, 28 June; ANDRE P. E. PLANIOL, New York, 61, aeronautical engineer and consultant at the Stratos Division of Fairchild Engine and Airplane Corp., 30 June; SAMUEL H. RONKIN, New York, 59, dentist, associate professor of anatomy at Temple University in Philadelphia, 27 June; NATHAN ROSENTHAL, New York, 65, hematologist, authority on leukemia, former professor of clinical medicine at the College of Physicians and Surgeons, author, 29 June.

LEO SHARTSIS, Bethesda, Md., 49, glass expert at the National Bureau of Standards, author, inventor, 26 June; GEORGE R. SHELTON, Washington, D.C., 66, retired ceramics technologist at the National Bureau of Standards, former instructor of ceramics engineering at North Carolina State College, 28 June; KELLOG SPEED, Chicago, 76, former professor of surgery at the University of Illinois, author, 2 July; EDGAR J. TOWNSEND, Champaign, Ill., 91, retired professor of mathematics and dean of the college of science at the University of Illinois, 8 July.

Education

■ Four Massachusetts secondary-school systems, 10 Massachusetts colleges, and the Harvard Graduate School of Education have established a new program intended to obtain able liberal arts and science graduates as elementary- and high-school teachers.

The core of the program is a summer school at Weeks Junior High School, Newton, where 20 master teachers will guide 60 selected student-teachers and 40 student-observers in the teaching of science, social studies, music, art, mathematics, shop, English, and French to 300 boys and girls. After the completion of summer-school training, a few of the student-teachers will be hired to teach, with guidance, at the same time that they carry on their advanced studies at Harvard.

The student-teachers who attend the summer school will be selected by a faculty committee at each of the 10 cooperating colleges. The college students who have taken certain college courses in preparation for teaching may qualify as teachers by taking the summer course in Newton. Others may use the summer course as a means of qualifying for employment as interns in one of the cooperating school systems while they complete their graduate studies.

Each school system will hire two intern teachers who will work under an experienced teacher in the school and together will fill one full-time teaching assignment. One student teacher will teach

full time during the fall term, carrying on studies centered on his own teaching experience under the Harvard faculty. During this term, the other student teacher will carry a full load of studies at Harvard, including a seminar in which he will learn of his partner's teaching experiences. At midyear the two will exchange places. The cooperating school systems are Concord, Newton, Weston, and Winchester. The colleges are Amherst, Harvard, Holy Cross, Massachusetts Institute of Technology, Mount Holyoke, Radcliffe, Smith, Wellesley, Wheaton, and Williams.

■ Special courses to prepare neurologists and ophthalmologists for careers in teaching and research will be started next fall in the University of Pennsylvania's Graduate School of Medicine. To initiate the program, the school has been awarded training grants totaling $126,000 for a 2-year period by the National Institute of Neurological Diseases and Blindness. Julius H. Comroe, Jr., professor of physiology, will be program director. The school will continue, meanwhile, to give its regular courses in neurology-psychiatry and ophthalmology for physicians in clinical practice.

Student-physicians will be given practice in such teaching situations as conferences, seminars and ward rounds. Instruction will be given also in the use of visual aids, planning of examinations, faculty-student relationships, medical writing, library use, and medical administration.

Candidates for the courses must be certified by the American Board of Neurology or the American Board of Ophthalmology, or must have met most of the requirements for certification. Preference will be given to doctors recommended by their own medical school faculties with the understanding that they will return for full-time teaching and research careers.

■ A comprehensive program of lectures on titanium, designed especially for practicing engineers, will be conducted at New York University College of Engineering 12–16 Sept. Engineers and scientists from industry and research laboratories and members of the university faculty will present 25 talks on the metal. The subjects to be covered are extraction and melting (12 Sept.); phase diagram metallography and alloying (13 Sept.); heat treatment and mechanical properties (14 Sept.); mechanical metallurgy, analysis, corrosion, and fabrication (15 Sept.); fabrication and applications (16 Sept.). Evening discussion sessions will supplement the lectures, which will be given at the University Heights campus in the Bronx.

The program is open to all persons with a general engineering and metallurgical background. Applicants may register *until 20 Aug.* for 1 day or more of the program. Dormitory space on the University Heights campus will be available from 11–17 Sept. Information and applications can be obtained by writing to Assistant Dean Wilbur K. McKee, Office of Special Services to Business and Industry, New York University, 6 Washington Square N, New York 3.

■ Establishment of a Natural Resources Institute to "stimulate and coordinate teaching and research in the conservation, development, and wise use of natural resources," has been authorized at Ohio State University. The new institute will be located within the College of Agriculture but will be university-wide in scope and service.

In authorizing the institute, the university's board of trustees made several recommendations, which will take effect 26 Aug. They include a reorganization of the university's Franz Theodore Stone Institute of Hydrobiology at Put-in-Bay, which will be renamed the Franz Theodore Stone Laboratory. The Put-in-Bay Laboratory will be placed under control of the executive director of the Natural Resources Institute. At the same time, the department of hydrobiology will be abolished, and its courses of instruction will be returned to various other teaching and research departments on the campus.

■ The United States and Norway have renewed for a second 5-year period an educational exchange agreement under the Fulbright Act. The agreement, signed in Oslo by the U.S. ambassador, L. Corrin Strong, and the Norwegian foreign minister, Halvard M. Lange, on behalf of their respective governments, provides the equivalent of $1.25 million in Norwegian kroner to continue the program for another 5 years at an annual expenditure of the equivalent of $250,000 a year. The money will be used to finance travel of Norwegians to the United States for study, teaching, lecturing, or advanced research, and to pay travel and maintenance costs for Americans to go to Norway for similar purposes. Nearly 900 exchanges have taken place since the program began in 1949.

Grants, Fellowships, and Awards

■ The National Science Foundation has announced a second program of postdoctoral fellowship awards for 1955–56. These new awards, like those in the first program, are for advanced study and training in the mathematical, physical, medical, biological, and engineering sciences, including anthropology, psychology (excluding clinical psychology), geography, and certain interdisciplinary fields.

Those eligible to apply are postdoctoral students, staff members, holders of the M.D. degree who wish to pursue advanced training and research in one of the basic medical sciences, and terminal-year graduate students who will receive the doctorate by February 1956. The National Academy of Sciences–National Research Council will again receive applications for the awards, evaluate them through its fellowship boards, and nominate candidates to the National Science Foundation.

Candidates must be citizens of the United States. Fellows will be required to devote full time to advanced scientific study or scientific research during the period of the fellowship award. A fellow may not receive remuneration from another fellowship, scholarship, or similar award or federal grant or contract during the tenure of the fellowship. Fellowships will be awarded on 20 Oct. Applications must be received in the Fellowship Office of the National Research Council, 2101 Constitution Ave., NW, Washington 25, D.C., *by 12 Sept.*

■ The New York Academy of Sciences has announced two prizes of $300 each, the A. Cressy Morrison prizes in natural science, for the two most acceptable papers in the field of science covered by the academy or its affiliates. Another prize of $500, the Boris Pregel prize, is offered for the best paper on radioactive substances. The papers should be submitted, in form ready for publication, *before 15 Oct.* Details may be obtained from the academy, 2 E. 63 St., New York 21.

■ Stanford Research Institute has been awarded a grant of $26,000 by the Rockefeller Foundation to assist the participation of foreign scientists and engineers in the World Symposium on Applied Solar Energy that is scheduled for 31 Oct.–4 Nov. at Phoenix and Tucson, Ariz.

The funds will enable more than 25 foreign scientists to take part in the symposium, which is being planned by the institute with the cosponsorship of the Association for Applied Solar Energy and the University of Arizona.

Priority in dispersing the funds will be given to those who have contributed most importantly to the field of solar energy research. However, partial assistance may be given to qualified researchers from countries whose contributions have been moderate but whose resources of solar energy are unusually large. Dispersal of funds will be determined by a committee on foreign delegates headed by Robert L. Woodcock of Stanford Research Institute.

Reports and Letters

Blood Volume of the Rhesus Monkey

In the course of an investigation of the hemopoietic response of the rhesus monkey to total-body x-irradiation, it became necessary to express data in terms of the average blood volume of these animals. A review of the literature failed to reveal this information and the study reported here was undertaken to establish this value.

Twenty prepuberty rhesus monkeys, 10 males and 10 females, were used in the study. For a period of 6 wk prior to the determinations, the animals were maintained on a standard laboratory diet. During this period the animals did not exhibit any sign of the diseases common to the species.

The blood-volume determinations were made according to the method of Aust *et al.* (*1*), using radioactive iodinated human serum albumin (IHSA) as the tracer agent. In brief, 2.0 μc of IHSA in a volume of 0.5 ml was injected into the right femoral vein of each animal. Ten minutes later, a sample of blood was withdrawn from the left femoral vein into a heparinized syringe. A 1.0-ml aliquot of this sample was then assayed in a well-type scintillation counter. Previously, 0.5 ml of the IHSA had been diluted to a total volume of 1000 ml. A 1.0-ml aliquot of this known dilution was used as a standard and was assayed in the same manner. The blood volume was computed by the following formula:

$$\frac{\text{Net counts/min of standard} \times 10^3}{\text{Net counts/min of sample}} = \text{B.V.}$$

The 20 animals included in this study weighed from 2.2 kg to 5.3 kg. The blood volumes ranged from 49 ml/kg to 71 ml/kg. The average blood volume was found to be 60.9 ml/kg, and the probable error of this mean is 0.96 ml/kg. This distribution about the mean closely corresponds to values given by Freinkel *et al.* (*2*) and Storaasli *et al.* (*3*) in similar studies performed on human beings.

Although human serum albumin is a foreign protein to these animals, the half-time of the plasma clearance of the IHSA was found to be 22 hr, and this approximates values reported by Storaasli (*3*) in human beings. In addition, repeated injections of this material into individual monkeys have not induced demonstrable foreign protein reactions.

M. A. Bender
Roswell Park Memorial Institute, Buffalo, New York

References

1. J. B. Aust *et al.*, *Proc. Soc. Exptl. Biol. Med.* 77, 514 (1951).
2. N. Freinkel *et al.*, *J. Clin. Invest.* 32, 138 (1953).
3. J. P. Storaasli *et al.*, *Surg. Gynecol. Obstet.*, 458 (1950).

18 April 1955

Identification of Vaccine Strains of Newcastle Disease Virus

Before random purity and potency tests can be applied to living virus vaccines for Newcastle disease, a practical method is needed for typing and identifying the strain of virus in the vaccine (*1*). Such a method based on several years of study of strains of virus from the Newcastle disease repository at Wisconsin (*2*) has been tested successfully, using samples of vaccines submitted by the Biological Products Section of the U.S. Department of Agriculture.

The vaccine sample is reconstituted so that 100 chicken vaccine doses are contained in 1 ml, and five tests are made on selected dilutions of the sample: LD_{50} for 10-day chicken embryos; mean death time of the minimum lethal dose; intracerebral pathogenicity for day-old chicks; susceptibility to neutralization by Newcastle disease virus antiserum of known titer; and bacterial contamination (*3*). Allanto-amniotic fluids harvested from embryos inoculated for the LD_{50} test are examined for equine erythrocyte agglutinins and for resistance of the fowl erythrocyte agglutinins to inactivation at 56°C.

The strains are typed according to their growth rate (*4*), which is measured by the mean death time of the minimum lethal dose. The lentogenic, or slowly growing, strains, which take 90 to 150 hr to kill embryos, include only a few strains that are all of low pathogenicity for chickens. Two strains are used in intranasal or aerosol vaccines. The mesogenic, or intermediate, strains, which take 60 to 90 hr to kill, include a larger group of strains possessing low to high pathogenicity for chickens. Two strains are used in wing-web vaccines. The velogenic, or rapidly growing, strains, which kill in 40 to 60 hr, include a large group of strains of moderate to high pathogenicity for chickens. All are unsatisfactory as vaccines.

The strain is defined by the use of additional test characteristics. A comparison (Table 1) of the four widely used American living virus vaccine strains—Bl, LaSota, Roakin, and MK107 (L), illustrates the use of definitive tests (tests 6 and 7) in conjunction with typing tests (tests 2 and 3).

The LD_{50} in test 1 is dependent on vaccine production procedure, such as the quantity of diluent and buffers used in packaging, and is not of diagnostic importance. The intracerebral pathogenicity index of lentogenic strains should be less than 0.25, so the index (test 3) helps to confirm the test for the mean death time (test 2). The capacity to agglutinate equine erythrocytes (test 6) differentiates the two strains in each type. Stability of the fowl erythrocyte agglutinins at 56°C (test 7) serves as an additional check on the strain definition, since all four strains should be inactivated in 15 min.

Some of the afore-described tests have been made on all of the 80 strains of Newcastle disease virus available in the repository, and other tests have been made on fewer of these strains. Twelve additional characteristics are being con-

Table 1. Characteristics of four vaccine strains

Sample	Test 1, LD_{50} (log)	Test 2, mean death time (hr)	Test 3, intracerebral pathogenicity (index)	Test 6, equine hemagglutinin (index)	Test 7, resistance, 56°C (min)	Diagnosis	
						Type	Strain
A	7	120	0.1	0	> 15	Lentogenic	Bl
B	7	100	0.1	0.4	> 15	Lentogenic	LaSota
C	5	70	1.1	0	> 15	Mesogenic	Roakin
D	5	60	1.1	0.5	> 15	Mesogenic	MK107 (L)

sidered and are particularly useful in differentiating velogenic strains (5). Studies on the genetic stability of certain test characters (6) indicate that, with proper precautions, the method suggested here for strain typing and differentiation can be successfully employed.

R. P. Hanson
C. A. Brandly
Departments of Veterinary Science and Bacteriology, College of Agriculture, University of Wisconsin, Madison

References and Notes

1. E. P. Johnson *et al.*, *J. Am. Vet. Med. Assoc.* 125, 441 (1954).
2. R. P. Hanson *et al.*, *Proc. Soc. Exptl. Biol.* 70, 283 (1949); N. S. Winslow *et al.*, *ibid.* 74, 174 (1950); E. Upton, R. P. Hanson, C. A. Brandly, *ibid.* 84, 691 (1953).
3. Control information only.
4. D. T. Karzon and F. B. Bang, *J. Exptl. Med.* 93, 267 (1951).
5. R. P. Hanson, special report to Agricultural Research Service, 22 Feb. 1955.
6. E. C. Goldman and R. P. Hanson, *J. Immunol.* 74, 101 (1955).

11 April 1955

Conditioned Aversion to Saccharin Resulting from Exposure to Gamma Radiation

It was previously observed (1) that the water and food consumption of rats was depressed during exposure to a relatively low dose of low-intensity gamma radiation. The severity of this depression increased with successive exposures to radiation, although consumption between exposures was similar to or exceeded that of nonirradiated controls. It was suggested that the progressive change in consummatory behavior during repetitive exposure may be, in part, a conditioned response in which the avoidance of water and food is strengthened by learning through repeated coupling with the radiation situation.

A clearer demonstration of the learning phenomenon would be provided if the conditioned avoidance of water or food could be elicited in the absence of radiation exposure. This report (2) describes the results of an experiment designed to provide such a test. The water available during irradiation was made discriminative to the animal, by the addition of saccharin. Subsequently, the saccharin flavor was employed as a taste stimulus in a postirradiation test for a conditioned aversion to the discriminative fluid.

The animals were Sprague-Dawley stock bred at this laboratory. Each animal was maintained in an individual cage. Two plastic 100-ml drinking bottles with glass nipples were attached to each cage except during specified periods. The difference in weight of each drinking bottle and of its contents before and after a given test period was used as the estimate of fluid consumption.

Eighty male rats from 16 litters were subjected to a preirradiation series of tests to determine their degree of preference of a 0.1-percent saccharin solution in relation to tap water. Both fluids were presented concurrently. Tests were also made to evaluate a possible position preference in drinking in the two-bottle situation. Very few animals exhibited a drinking-bottle position preference strong enough to overcome their preference for saccharin. As a result of these tests, 20 animals with the lowest preference for the saccharin solution and/or the highest position preference were eliminated. The remaining animals were randomly assigned to six groups, with the restriction that each group contain at least one member, and not more than two members, from each litter. The experimental treatment for each group is shown in Table 1.

For radiation exposure, all animals were confined in Lucite boxes and exposed in the gamma field of a 7-c cobalt-60 radiation source. Attached to each box was a single plastic drinking bottle that contained either tap water or saccharin solution, as specified in the experimental design. The 30-r and 57-r exposures were made at radiation intensities of 5.0 r/hr and 9.5 r/hr, respectively. The sham-irradiated groups were placed in the radiation field behind a lead shield. The total exposure period was 6 hr for all groups.

Measurements of fluid consumption

Table 1. Experimental treatment for each group.

Group	No. of animals	Radiation exposure dose (r)	Fluid present during exposure
I	10	0	Tap water
II	10	0	Saccharin solution
III	10	30	Tap water
IV	10	30	Saccharin solution
V	10	57	Tap water
VI	10	57	Saccharin solution

Table 2. The median saccharin solution preference score for each group during the initial 48-hr postirradiation test period

Radiation dose (r)	Groups II, IV, VI (saccharin present during irradiation)		Groups I, III, V (water present during irradiation)	
0	88.0	(11.0)*	93.2	(2.3)
30	33.4	(9.8)	94.8	(8.2)
57	3.1	(3.7)	96.8	(1.8)

* Standard error of the median.

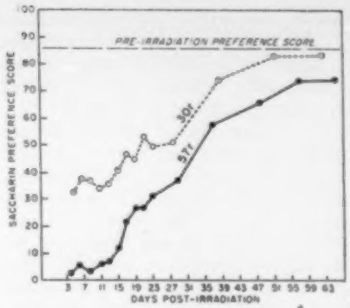


Fig. 1. Median saccharin preference scores for animal groups exposed concurrently to gamma radiation and saccharin-flavored drinking water.

indicated that all animals had tasted the fluid presented to them during radiation exposure. On day 1 postirradiation, the groups that had received water during exposure were presented with the saccharin solution only for 6 hr, and the other groups received water only in order to equalize the experience with saccharin. On day 2 postirradiation, saccharin solution and water were simultaneously available to each animal for a 6-hr period. Beginning with the day 3 postirradiation, both saccharin solution and water were available to each animal on a continuous basis. Measurements of consumption were made at 24-hr intervals.

During the postirradiation preference testing period, the drinking bottles were reversed daily to avoid a stereotyped position response. An effect of position was not detectable when the saccharin preference was distinctively high or low. However, when the scores were in the neutral range of preference, a position effect could be detected. In order to minimize the effect of position on the scores, each consecutive left and right measurement pair are combined for each animal, and 48-hr values are reported.

The saccharin preference score utilized is the quotient for the ratio

$$\frac{\text{Saccharin solution intake (g)}}{\text{Total fluid intake (g)}} \times 100$$

The median preirradiation saccharin score for all animals was observed to be 86.1 (S.E. = 1.0) for two 6-hr test periods; that is, the saccharin solution constituted 86.1 percent of the total fluid consumption. The results of the initial postirradiation preference test period for each group are summarized in Table 2. Animals presented with saccharin during the sham-irradiation (0 r) maintained their preference during the postirradiation test period. However, animals that were exposed to 30 r or 57 r with saccharin available during irradiation exhibited a marked decrease in their pref-

erence score in the postirradiation test (Table 2). Exposure to 30 r was sufficient to negate the previous preference for saccharin, while exposure to 57 r resulted in a striking aversion to saccharin.

The consumption of saccharin and tap water was determined daily for 20 days and then at intervals of 2 to 5 days during the next 40 days. The saccharin preference scores for groups that had saccharin available during irradiation are summarized graphically in Fig. 1. The conditioned aversion to the discriminate fluid was still present 30 days after irradiation, although some extinction was apparent.

The use of saccharin solution in the present study has made it possible to demonstrate the effectiveness of ionizing radiation to act as an unconditioned stimulus in animal behavior. Rats tend to avoid a taste stimulus that has been associated with radiation exposure, although the stimulus is usually preferred. The conditioned aversion to saccharin is relatively radiosensitive, being effected by a 6-hr coupling with a 30-r dose of low-intensity (5 r/hr) gamma radiation. The conditioning appears to be dose-dependent in terms of the strength of saccharin aversion and in the persistence of this aversion.

Although the conditioned aversion in this study is dependent on taste discrimination, it may be symptomatic of broader behavioral disturbances instigated during radiation exposure. If this is true, then it should be possible to detect avoidance behavior with stimuli other than taste. Such studies are now in progress.

The processes through which radiation is capable of operating as an unconditioned stimulus are unknown. Since consummatory behavior is partially a reflection of gastric function, it is plausible to suspect gastrointestinal disturbances as the physiological events that motivate the animal in the learning situation. Gastrointestinal functions are known to be disturbed during irradiation and are responsive to the same magnitude of radiation dose (3).

J. GARCIA
D. J. KIMELDORF
R. A. KOELLING

Division of Biology and Medicine, U.S. Naval Radiological Defense Laboratory, San Francisco, California

References and Notes

1. J. Garcia *et al.*, U.S. Naval Radiological Defense Laboratory, Rpt. *USNRDL-TR*-19 (1954).
2. This study was supported in part through funds provided by the School of Aviation Medicine, U.S. Air Force. The opinions or assertions contained herein are the private ones of the authors and are not to be construed as reflecting the official views of the Defense Department.
3. T. Toyama, *Tôhoku J. Exptl. Med.* **22**, 196 (1933); R. A. Conard, *Am. J. Physiol.* **165**, 375 (1951).

17 March 1955

Intolerance of Dizygotic Human Twins to Reciprocal Skin Homografts

Skin homografts transplanted between two human individuals of ordinary genetic diversity are almost invariably rejected by the host individual (*1*). When homografts are exchanged between monozygotic, or "identical," human twins, however, they survive permanently (*1*). With one possible exception (*2*), the behavior of skin homografts in dizygotic, or "fraternal," human twins has not been reported in the medical literature. Meyer-Burgdorff (*2*) described the rejection of skin homografts in a pair of twins whom he regarded as monozygotic, but the diagnosis of monozygosity was not based on objective criteria.

Skin homografts exchanged between dizygotic twin cattle frequently survive indefinitely (*3*) and behave in all respects like autografts. This is in contrast to the rejection of homografts exchanged between ordinary cattle siblings or between dizygotic twin sheep (*4*). The contrast between cattle and sheep in this respect has been attributed (*5*) to the interchange of fetal blood in cattle twins, as is evidenced by the occurrence of freemartins in cattle. Furthermore, in cattle each member of a dizygotic twin pair usually has two types of red blood cells, a heterogeneity suggestive of an actual transplantation of blood-forming tissues by way of the fetal vascular anastomoses. Such animals are spoken of as erythrocyte chimeras (*3*). At least one such chimera has been described in man (*6*).

The present tests were performed in the hope of determining the zygosity of two pairs of twins that presented difficulty in a twin study on mental deficiency (*7*). Both pairs of twins had identical blood antigens and very similar dermatoglyphic patterns. Blood of all four twins was examined at the Knickerbocker Foundation, for heterogeneity of the red blood cells in respect to the ABO antigens, with negative results. Since in each case one twin was severely defective, both mentally and physically, ordinary morphological criteria of zygosity could not be relied upon. In one set of twins, 13-year-old girls, the defective member had microcephaly of postnatal origin, retrolental fibroplasia, and a symmetrical growth anomaly of the toes. The other set of twins were 11-year-old boys, of whom one was a mongoloid imbecile; the mongoloid had a moderate amount of brown (superficial) eye pigmentation that was lacking in his brother. A more detailed report of these cases is in preparation.

Full-thickness, circular skin homografts were reciprocally transplanted in corresponding defects made on the volar surface of the left forearms of each of the two sets of twins. Follow-up examinations made through the ninth week after transplantation confirmed survival of the homografts in the twin girls, indicating a probable monozygotic relationship. Between the 18th and 22nd postoperative days in the twin brothers, however, a sudden violent rejection of the skin homografts occurred. This was evidenced by a marked induration, redness, vascular thromboses, hemorrhage, eventual gangrene, and rapid sloughing of the entire full-thickness of skin in both twins. Except for this relatively delayed reaction, the phenomena observed were identical to those associated with the sloughing of skin homografts between two unrelated individuals (*1*). The result was taken as evidence that the twin brothers were dizygotic in origin.

The senior author is conducting further studies on the behavior of skin homografts in dizygotic twins.

BLAIR O. ROGERS
GORDON ALLEN

Department of Plastic Surgery, St. Barnabas Hospital, Newark, New Jersey, and *National Institutes of Health, Bethesda, Maryland*

References and Notes

1. B. O. Rogers, *Plast. Reconstr. Surg.* **5**, 269 (1950); *ibid.* **7**, 169 (1951); *Transplantation Bull.* **1**, 58 (1954); *ibid.* **2**, 29 (1955).
2. Meyer-Burgdorff, *Zbl. Chir.* **58**, 1337 (1931).
3. D. Anderson *et al.*, *Heredity* **5**, 379 (1951).
4. G. H. Lampkin, *Nature* **171**, 975 (1953).
5. R. D. Owen, *Science* **102**, 400 (1945).
6. I. Dunsford *et al.*, *Brit. Med. J.* **II**, 81 (1953).
7. This work was part of a study of mental deficiency in twins now in progress at the Department of Medical Genetics of the New York State Psychiatric Institute. The larger project is under the joint supervision of Franz J. Kallman and the Laboratory of Socio-Environmental Studies, Research Branch, National Institute of Mental Health, U.S. Public Health Service. The Psychiatric Institute provided facilities for the skin-grafting operations.

31 March 1955

C^{14}-Acetate Incorporation into Liver Lipids and Glycogen of Irradiated Rats

In vivo differences in C^{14}-acetate incorporation into glycogen and lipids of the liver have been studied in normal and irradiated animals (*1*). Previous investigations into the effects of irradiation have been concerned with either glycogen or fatty acids. Denson *et al.* (*2*) have reported liver glycogen increases in rats starved 24 hr postirradiation, while Ross and Ely (*3*) have shown that liver glycogen appeared within 3 hr after x-ray exposure. However, Fishel (*4*) has reported diminishing glycogen deposition after irradiation, and Prosser (*5*), studying the later effects, observed low liver glycogens. In fasted irradiated rats,

Table 1. Effect of irradiation on acetate-C^{14} incorporation into liver glycogen and fatty acids

No. of animals	Dose (r)	Starvation period (hr)	Liver glycogen (%)	Total counts	Liver fatty acids (%)	Total counts
8	0	0	3.4	66	3.7	220
8	0	48	0.5	79	3.8	45
8	1500	48	3.4	203	4.2	410
7	1500	24/24*	2.7	95	3.7	217
8	1500	48/24†	3.7	176	3.7	151

* Animals fasted 24 hr before and after irradiation.
† Animals fasted 48 hr before and 24 hr after irradiation.

Table 2. Effect of irradiation on incorporation of acetate-C^{14} into liver lipid fractions

No. of animals	Dose (r)	Starvation period (hr)	Liver phospholipids (mg)	Total counts	Liver neutral fat (mg)	Total counts
6	0	48	187.1	50	112.1	69
8	1500	48	185.3	51	113.8	142

liver glycogen was found by McKee (*6*) to be higher than in fasted controls. This effect was first ascribed to retarded glycogenolysis. Fasting preliminary to x-ray exposure indicated, however, that the high levels might be the result of glycogen formation. Our studies have pursued this line and have further employed the incorporation of labeled acetate to compare the metabolic activity in irradiated and normal animals.

Coniglio *et al.* (*7*) found an increase in the incorporation of intraperitoneally administered C^{14}-acetate into liver fatty acids of x-rayed animals. Since Neve and Entenman (*8*) observed increases in blood phospholipids, which might be a reflection of liver synthesis, the liver lipids of two groups of animals were fractionated into phospholipids and neutral fat. Thus in these studies interest was also centered on the particular lipid fraction into which acetate incorporation occurred.

Female albino rats weighing 175 ± 15 g were given a single dose of 1500 r with a G.E. Maximar x-ray and were fasted 24 or 48 hr. They were then fed 0.02 mg of sodium acetate-1-C^{14} (0.2 μc) dissolved in 0.5 ml of water. After 2 hr the animals were sacrificed. The livers were isolated, weighed, and immediately placed in hot potassium hydroxide. After the mixture was heated 5 hr the glycogen was obtained by successive precipitation with 60-percent ethanol. The liver fatty acids were extracted with ethyl ether from the acidified ethanol supernatant. The results of these analyses are shown in Table 1.

Significant increases in the percentage of liver glycogen can be seen in all fasted irradiated animals as compared with fasted controls. In the last group, in which the starvation period would have reduced the values comparable to the controls (0.5 percent), the glycogen value of 3.7 percent obtained 24 hr postirradiation could best be explained by synthesis of glycogen. This does not support Denson (*2*) and others who attribute the increased glycogen to a retardation of glycogenolysis but does support McKee's suggestion that liver glycogen after irradiation is produced by glyconeogenesis. Increased synthesis could result from the utilization of fragments released by the cellular breakdown that accompanies x-irradiation.

An accelerated metabolism caused by a greater supply of glycogen-forming intermediates would also explain the increased C^{14}-incorporation into glycogen in the animals fasted 48 hr before irradiation. Hughes and Tolbert (*9*), administering amino acids and carbohydrates, and Morehouse and Searcy (*10*), feeding lipids, have shown that greater amounts of C^{14}-carbon dioxide are expired from irradiated animals than from normal animals. Further investigations are planned to determine the rates of release of C^{14}-carbon dioxide after labeled-acetate feeding.

The total fatty acids of the liver show that irradiation increases the incorporation of C^{14} some tenfold over that of the fasted controls. This could be caused by a net synthesis of fatty acids from acetate, even though the amounts are not sufficient to be seen in inereased weight of fat.

In two more groups of animals, the lipid fraction that incorporated the greatest amount of C^{14} was determined. These animals were treated as before, except that the livers were extracted for total lipids. This total lipid was divided into neutral fat (acetone soluble) and phospholipids (acetone insoluble). The results are shown in Table 2.

No differences in the incorporation of the label or in the absolute amounts of phospholipids isolated from the two groups of animals can be seen. Thus it does not appear that irradiation has appreciably affected the synthesis of phospholipids from fatty acids in the liver during the period studied. Although the amount does not increase significantly, the incorporation of C^{14} into the neutral fat of the irradiated animals is about twice that of the normals. This result is consistent with that found for the total fatty acids and could possibly also be explained by a somewhat greater net synthesis of the fatty acids in the neutral fat. The magnitude of the synthesis could be too small in the period studied to be reflected in an increased weight which might further be kept constant by the needs of metabolic processes. From these results it is concluded that irradiation affects the incorporation of labeled acetate into the neutral fat fraction more than into the phospholipid fraction.

Further work is contemplated to give substantiation and elucidation to these observations.

MARGARET G. MOREHOUSE
RONALD L. SEARCY
Department of Biochemistry and Nutrition, University of Southern California, Los Angeles

References and Notes

1. This research was supported by a grant from the U.S. Atomic Energy Commission, contract AT(11-1)-113, project 6, and conducted through the laboratory facilities of the Allan Hancock Foundation.
2. J. R. Denson *et al.*, *Proc. Soc. Exptl. Biol. Med.* **82**, 707 (1953).
3. M. H. Ross and J. O. Ely, *J. Cellular, Comp. Physiol.* **37**, 163 (1951).
4. E. Fishel, *Schweiz. med. Wochschr.* **71**, 764 (1941).
5. C. L. Prosser, quoted by Lourau *et al.*, *J. physiol. (Paris)* **43**, 593 (1951).
6. R. W. McKee, *Federation Proc.* **11**, 256 (1952).
7. J. Coniglio, *ibid.* **13**, 194 (1954).
8. R. A. Neve and C. Entenman, USNRL Rept. AD-307(B), (1951).
9. A. M. Hughes and B. M. Tolbet, UCRL Rept. 2709 (1954).
10. M. G. Morehouse and R. L. Searcy, unpublished data.

9 February 1955

Aerial Blobs

Twinkling of the stars has its origin in the temporary fading of their light and in lateral excursions of their images. These variations in light intensity and position of the stars are caused by disturbances in the earth's atmosphere.

In this paper attention is called to

some striking features of the stellar scintillations and excursions that are due to what I propose to call *aerial blobs* (*1*). Although many atmospheric disturbances refract, diffract, scatter, or absorb light from distant celestial and terrestrial sources in an irregular manner, aerial blobs are volumes of air of locally altered density, temperature, and water content that possess remarkable optical properties. Blobs in combination with the mirrors or lenses of a telescope often bodily displace the images of stars or focus them in points in front or behind the regular focal surface, as is shown in Fig. 1.

Figure 2 (top) depicts the structure of a typical extrafocal stellar image as obtained from an instantaneous exposure with the 200-in. telescope. The extrafocal image shown is composed of a network of dark and bright patches and lanes. (The inner circle is due to the obstruction offered by the observer's cage.) Notice the distinct points *A*, *B*, *C*; these are good stellar images resulting from the combined optical action of the telescope and various aerial blobs traveling through the cylindrical beam of light from a given star falling on the 200-in. mirror. If, instead of taking a still picture, the photographic plate is moved in a plane normal to the axis of the telescope, the

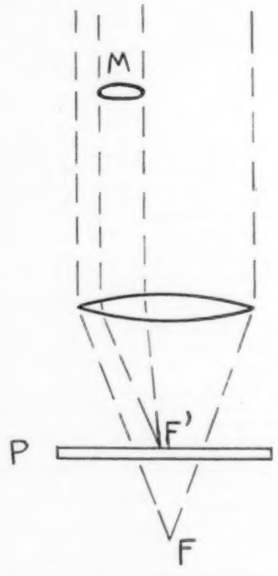


Fig. 1. The combined optical action of the aerial blob *M* and a telescope lens (or mirror) focus parallel starlight at *F'* instead of at the ordinary focus *F* for an undisturbed atmosphere. *P* is the photographic plate.

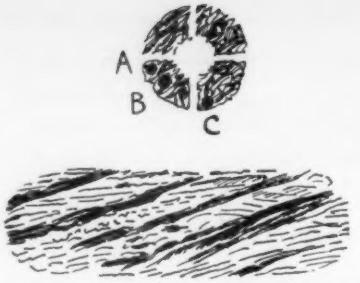


Fig. 2. (Top) Possible structure of extrafocal stellar image of the 200-in. telescope with sharp focused star images at *A*, *B*, *C*, which are due to the combined optical action of the 200-in. mirror and aerial blobs approximately 20 to 30 in. in size. (Bottom) Drifted extrafocal image.

points *A*, *B*, *C* will produce sharp striations. These will be inclined as shown if the blobs have any velocity component normal to the motion of the plate (Fig. 2, bottom).

Linear dimensions of aerial blobs have been observed ranging from millimeters to many meters. Blobs may be globular, lenticular, or cylindrical in shape, thus producing sharp pointlike or linelike extrafocal images of stars. Often hundreds of blobs are quite regularly spaced and drift with the winds at various altitudes up to 50 km or perhaps higher. Methods for the determination of the physical characteristics of aerial blobs, of their velocities, and of the altitudes at which they are found have been discussed in another place (*2*).

A most amazing feature of many aerial blobs is their durability and stability; some of them preserve their shapes for hours. The lifetime of blobs can best be observed through the partial or total condensation of their moisture content. Such condensation occurs, for instance, in the regions adjoining the vapor trails caused by jet planes.

It is often thought that the continued state of commotion is one of the most conspicuous features of the atmosphere. Individual disturbances such as eddies, shock waves, and other local fluctuations of density, pressure, and temperature are commonly pictured as fleeting and short lived. On closer inspection it will be noticed, however, that stationary cloud formations represent an important aspect of the atmosphere. In particular, semiperiodically distributed globular and striated Cirrus clouds may be intrinsically of the same nature as the afore-mentioned aerial blobs.

The reasons for the durability of aerial blobs are not yet well known. The suggestion may be ventured that their stability is related to the thermal, caloric, and electric phenomena that governs and regulates the water content of the blobs. For instance, heat flowing in and out of a blob will cause some of its moisture to evaporate or to condense. The resulting absorption or release of the heat of vaporization of water tends to stabilize the temperature within the blob at a constant differential relative to the surrounding air. Also, the droplets or ice crystals are positively and negatively charged. The whole swarm of condensed particles thus possesses a negative potential energy, which helps to maintain the physical conditions within the blob.

The simple optical tests discussed here promise to produce a wealth of information on all the important disturbances in the earth's atmosphere. The study of extrafocal images of bright stars, as well as the analysis of drifted spectra (*2*), are particularly useful and are well within the reach of instrumental equipment available to many meteorologists, amateur astronomers, and photographers, who should therefore be encouraged to lend a hand in the exploration of phenomena important for meteorology, to the art of forecasting, and to the study of the physics of the atmosphere.

F. Zwicky

Mount Wilson and Palomar Observatories, Pasadena, California

References and Notes

1. During my lectures in Paris and Göttingen in the summer of 1954, I used the expressions *mollusques d'air* and *Luftmollusken*, since no good direct translations for the word *blob* are available.
2. F. Zwicky, *Publ. Astron. Soc. Pacific* **62**, 150 (1950); *J. Am. Rocket Soc.* **23**, 370 (1953).

15 March 1955.

Prizes and Awards

In reading the editorial in *Science*, 13 May 1955, I was rather astonished by the statement ". . . and the fact that one in seven of them have since received the highest honor that can come to a scientist. . . ."

In 1907 Michelson was awarded the Nobel prize and also the Copley medal. I asked him which he prized the most. He replied, "The Copley medal by all odds. It is awarded by my peers. At the same time I am glad to be able to remodel my house."

George Winchester

110 North 6th Avenue, New Brunswick, New Jersey

16 May 1955

Book Reviews

Advances in Carbohydrate Chemistry. vol. 9. M. L. Wolfrom, R. S. Tipson, and E. L. Hirst, Eds. Academic Press, New York, 1954. xviii + 426 pp. Illus. $10.50.

This volume continues the timely and well-documented presentations characteristic of its predecessors. In the first chapter R. U. Lemieux discusses "Some implications in carbohydrate chemistry of theories relating to the mechanisms of replacement reactions." The reactions of *O*-acyl derivatives of sugars, glycosides, and glycosyl halides are described. An attempt is made to generalize the various reactions that these compounds undergo, but the author is careful to point out known exceptions. This chapter will also provide many interesting ideas to those engaged in the synthesis of glycosides.

The chapter on "Alkali-sensitive glycosides," by C. E. Ballou, emphasizes mechanisms proposed for the hydrolysis of glycosides of phenols, enols, and beta-substituted alcohols.

"The 2-hydroxyglycals," by Mary G. Blair, is a brief review of the preparation, proof of structure, and chemical reactions of this series of compounds. A table of the properties of 2-hydroxyglycals and their conversion products is included. This chapter emphasizes that a great deal of work remains to be done in this field.

The chapter on "The methyl ethers of hexuronic acids," by G. O. Aspinall, continues the review of methyl ethers of sugars undertaken in previous volumes.

"The raffinose family of oligosaccharides," by D. French, is a well-written and thoroughly documented account. Following a discussion of the methods useful in oligosaccharide chemistry, the chapter relates the proof of structure of these compounds in order of their increasing complexity.

The inclusion of the chapter on "The conjugates of D-glucuronic acid of animal origin," by R. S. Teague, continues the discussion of these compounds undertaken in volume 8 of this series. Of considerable interest is a treatment of the intermediary metabolism of D-glucuronic acid and its conjugates.

"Paper chromatography of carbohydrates and related compounds," by G. N. Kowkabany, includes a useful correlation of R_f values with structural features. Color reagents, solvents, and methods of quantitative analysis are included. This chapter is probably the most thorough treatment of this subject available.

Other chapters include "Color and turbidity of sugar products," by R. W. Liggett, and V. R. Deitz, and "Carboxymethylcellulose," by J. V. Karabinos and Marjorie Hindert. I highly recommend this volume.

MILTON PAUL GORDON
Sloan-Kettering Institute for Cancer Research

L'Analyse Spectrale Quantitative par la Flamme. pt. I, Propriétés de la flamme. Réalisation et utilisation; pt. II, Analyse des émissions dans la flamme. R. Mavrodineanu and H. Boiteux. Masson, Paris, 1954. 247 pp. Illus. Cloth, F. 4.300; paper, F. 3.800.

The spectral emission of flames has assumed increasing importance in recent years, both for fundamental studies of combustion processes and for applications to the analysis of mixtures. This book is designed primarily for the analyst who is concerned with the field of flame applications and who is interested in the combustion process as it affects sensitivity and reproducibility of analytic determinations. However, there is an abundance of tabular and graphic information in this book that will interest the investigator of fundamental flame processes as well.

The book is divided into two parts: the first, by Mavrodineanu, covers the properties of flames, regulation of flow rate and pressure, burners, interferences, and photographic and photoelectric measurement of flame emission; the second, by Boiteux, treats the theory of atomic and molecular spectra, spectra of flames of air-acetylene and oxygen, and excitation of elements in the flame. This is followed by an extensive appendix giving tables of wavelengths and band heads observed in air-acetylene and oxygen-acetylene flames, 11 pages of plates showing the spectra of various elements in flames, a bibliography, a subject index, an author index, and table of contents.

The treatment of instruments and techniques is informative but incomplete, particularly with respect to modern flame photometers. Burners used in American flame photometers are mentioned but are not discussed in detail, probably because of the authors' unfamiliarity with this equipment. The theoretical treatment and the considerable amount of factual data are excellent. The serious investigator of flames and their analytic applications will find this book to be a useful contribution.

BOURDON F. SCRIBNER
Spectrochemistry Section, National Bureau of Standards

The Chemistry of Portland Cement. Robert Herman Bogue. Reinhold, New York, ed. 2, 1955. xix + 793 pp. Illus. $16.50.

The author of this book has achieved well-deserved international eminence as an authority on cement chemistry. From 1924 until his retirement within recent months, he was director of the Portland Cement Association fellowship at the National Bureau of Standards.

The first edition was published in 1947 and filled a gap in the existing literature. This second edition, which follows the same pattern as the first, is still unique in its field. No other book in English provides such a thorough résumé of the research literature. Robert Bogue has not been content to present only the later material but has provided historical perspective throughout. He has been a faithful reporter of the various investigators' material. Indeed, one could wish that he had given the reader more of his own viewpoint. However, the volume of work that has been done by Bogue's own staff is extensive, and accounts of it occupy a significant, although not disproportionate, fraction of the book.

This is primarily a book for the research chemist; but it can be used profitably for reference by the operating chemist and by others also. The initial chapters present an interesting history of the cement industry, a survey of various types of cement, and a concise account of portland cement manufacture. The main content is in three parts: "The chemistry of clinker formation," "The equilibria of clinker components," and "The chemistry of cement utilization."

The new edition has been brought up to date by the incorporation of a large amount of recent material. The number of pages has increased from 572 to 793, but this is partly the result of the use of larger type, a distinct improvement. A better conception of the amount of new material can be gained from the nearly 50-percent increase in literature references. The total is now nearly 1300. Owing to some duplication of references from chapter to chapter, this figure is

larger than the number of independent references, but it is still striking testimony to the industry of the author. The book is truly a comprehensive work and a boon to the literature searcher.

The larger type and other changes in styling have given the volume a distinctly improved and attractive appearance. It is well illustrated.

HAROLD H. STEINOUR
Literature Research Section, Portland Cement Association

La Végétation de Kaniama (Entre-Lu-ishi-Lubilash, Congo Belge). Série Scientifique No. 61. William Mullenders. Institut National pour l'Etude Agronomique de Congo Belge, Brussels, Belgium, 1954. 499 pp. Illus. + plates. Paper, F. 180.

This book presents the results of the botanical part of a detailed pedo-botanical survey of an irregular area of several hundred square kilometers in south-central Belgian Congo. The Braun-Blanquet system of formally named, hierarchically arranged vegetational units is used throughout. Twenty-nine such units are recognized, of which several are "new." As with other treatments in which the units of vegetation are so finely and (to judge from the maps) precisely divided, the status and significance of these units in relation to a larger region are obscure.

The evidence from the area studied is considered to corroborate the view, previously advanced by others, that the extensive savannahs in the Belgian Congo lying between the equatorial forests and the more southern, dry and open forests are anthropic rather than climatic, with fire as a principal factor. Two main climax types, both dense forests of Guinean affinities, are recognized in the area, correlated with the nature of the soil and underlying rock. These forests are now largely destroyed and replaced by savannahs rich in Sudano-Gambesian elements.

Eight hundred sixty-five species of vascular plants are recorded from the area, each represented by one or more collections deposited at the herbarium of the Institut National pour l'Etude Agronomique du Congo Belge, at Yangambi, C.B., and at the Jardin Botanique de l'Etat, Brussels. The identifications have been carefully done, with the help of well-known specialists in some groups.

Mullenders' detailed, thoughtful, and technically competent work provides some of the basic data toward an understanding of the vegetation of tropical Africa.

ARTHUR CRONQUIST
New York Botanical Garden

Deterioration of Materials. Causes and preventive techniques. A collaboration under the joint auspices of the Service Technical Committee of the Department of Defense (contract No. N7-mr-29127) and the Prevention of Deterioration Center, Division of Chemistry and Chemical Technology, National Academy of Sciences–National Research Council. Glenn A. Greathouse and Carl J. Wessel, Eds. Reinhold, New York, 1954. xvii + 835 pp. Illus. $12.

Deterioration of materials is constantly going on around us, but only when we are faced with the cost of a repair or replacement do we give the matter much thought. That deterioration of materials associated with our daily life and our industries is important is highlighted by the conservative figure of $12 billion, exclusive of foodstuffs, used by the editors of this book in assessing the nation's annual loss.

World War II was instrumental in demonstrating to our government, industry, and men in the armed services the terrific cost potential of deterioration. As a result, attention was focused on the entire problem. Problems of decay, corrosion, water damage, and weathering, which had been present but not extremely acute in our temperate zone, assumed tremendous importance when we were fighting a global war, with men and materiel exposed to all the known extremes of climatic conditions.

In compiling the most up-to-date information on deterioration in one book, the editors hope that it will serve as a guide to those engaged in the handling of materials everywhere as well as stimulate further research in unsolved areas of deterioration. Some of this information has been known for years and has been published in various journals and books, other data are the result of recent research dating from the early 1940's.

Each chapter was prepared by one or more specialists in the field, and the authors are to be complimented on striking a happy balance between condensation and information, while at the same time presenting their material in a readable, logical way. Those interested in a single material or a single aspect of deterioration may feel that too much has been sacrificed for brevity's sake. However, for those who wish to pursue a subject further, a list of literature citations and, in some instances, an additional bibliography included at the end of each chapter will be of great value.

Although it would be unjust to say that any one part or chapter was more important than the others, I wish to call particular attention to those chapters in part I that so clearly set forth some of the factors that bring about deterioration. Solutions to deterioration problems come only through an understanding of those climatic, chemical, physical, and biological factors and an appreciation of their importance.

Part II is concerned with individual materials and their reaction to the several factors of deterioration. In general, the problem of deterioration prevention is somewhat simpler when one deals with individual materials than when several materials are brought together in one unit. Part III describes the deterioration problems and the prevention methods that have been developed for two general classes of assembled units.

The three chapters in part IV deal with quite diverse subjects, but all are important in the over-all field of deterioration. "Dehumidification," the title of Chapter 13, is not particularly informative. The chapter deals with storage of materials in a relatively dry atmosphere. Techniques developed by the U.S. Navy, which is successfully using this preservation method for both ships and warehouse-stored material, are described.

The appendix deserves mention because it gives information on sources and identifying symbols of government specifications.

The editors and authors are to be complimented on gathering this information into one volume. The book should be of value to all who are in any way concerned with deterioration, whether in industry, research, or government service. As one who was associated with packaging of war materiel during World War II, I only wish that such a book had been available in 1942.

FRED E. DICKINSON
Department of Wood Technology, University of Michigan

Contributions to the Theory of Partial Differential Equations. L. Bers, S. Bochner, and F. John, Eds. Annals of Mathematics Studies, No. 33. Princeton Univ. Press, Princeton, N.J., 1954. vi + 257 pp. Paper, $4.

In October 1952 a conference on partial differential equations organized and sponsored by the National Academy of Sciences–National Research Council was held at Arden House, Harriman, N.Y. Fifteen papers presented there and subsequently submitted for publication are collected in this volume. Their authors are well-known specialists in the field of partial differential equations connected with various American universities: Bergman, Bers, Bochner, Browder, Diaz, Douglis, John, Lax, Leray, Loewner, Milgram, Morrey, Nirenberg, Protter, and

Rosenbloom. Some of the papers are the usual type of research papers, complete with detailed definitions and proofs; others give a review of recent advances made by their authors and their associates or announce results of work that is in progress. Most have extensive bibliographies appended to them.

Taken together, the papers give a fairly comprehensive picture of the progress that has been made in the theory of partial differential equations during the last 10 years, at least in this country. The progress is impressive. It is concerned with the classification of partial differential equations of higher order and of systems with respect to their type, roughly elliptic, parabolic, or hyperbolic, the appropriateness of various problems for each of these types, the function-theoretic behavior of the solutions, with the most emphasis on their regularity properties, but with some attention to their singular behavior, the "coherence" of the solutions with the coefficients of the equations and with the initial and boundary data. It is remarkable to what extent these specific problems of classical analysis are attacked by the concepts and the methods of modern abstract functional analysis. Although this volume will probably be studied only by those who work in this or a related field, it is an important guide to present research in this very active and fascinating branch of mathematics.

MICHAEL GOLOMB
Department of Mathematics,
Purdue University

Mosquitoes: Their Bionomics and Relation to Disease. William R. Horsfall. Ronald Press, New York, 1955. viii + 723 pp. $16.

William Horsfall has given, in this book, a general review of the literature on mosquito biology, with particular emphasis on studies of life-histories and behavior and on relationships with disease-producing organisms. The material is arranged by taxonomic categories. There is a discussion, some 40 pages long, of the general characteristics of the subfamily Culicinae, followed by summaries of the pertinent literature on each genus and species. The author's intention seems to be to supply a reference book for mosquito workers, rather than a review for general biologists. The book forms a sort of gigantic abstract and index of the mosquito literature, with little attempt at evaluation or generalization. This indeed is almost automatically precluded by the taxonomic arrangement of materials.

The coverage of the literature is thorough and the material, particularly in relation to phenomena of disease transmission, is frequently arranged in convenient tabular form. It is unfortunate, from the point of view of reference, that the bibliography is given in skeleton form, without titles of journal articles. This makes it difficult for the user of the book to decide which citations to look up when he is searching for further material on a particular topic. Further, there is no author index and no subject index to topics such as oviposition, food behavior, light reactions, and the like. The material is clearly enough arranged under each species, but the user, to find this, must know which mosquito species are likely to have been studied from this point of view. The book thus presupposes a considerable knowledge of mosquitoes on the part of the user; for people with such background, it will be a great convenience.

MARSTON BATES
Department of Zoology,
University of Michigan.

Degradation of Vinyl Polymers. H. H. G. Jellinek. vol. III of *Physical Chemistry,* A series of monographs. Eric Hutchinson, Ed. Academic Press, New York, 1955. 329 pp. Illus. $8.50.

Synthetic polymers are extremely important to our modern civilization. This is evident when we consider the enormous amounts used as plastics, rubbers, and textiles. Unfortunately, their chief disadvantage is often a susceptibility to chemical changes in relatively short periods of time owing to heat, light, and oxygen or other chemicals in the air, which render them less and less useful. Considering the greatly increased production of these materials and our increasing dependence on them, it is apparent that investigations of the type reviewed in this book are of great value in promoting more intelligent and efficient utilization of such materials.

Numerous chapters on this subject have appeared in other books on polymers and related subjects during the period of the last 20 years. However, this book comes at a time when the number of studies on the decomposition of polymers by a variety of means—thermal, light, atomic radiation, ultrasonics, and chemical—is increasing at an accelerated pace.

This book attempts not only to review the formal kinetic theories of degradation but also to discuss possible actual mechanisms. Although it is quite free of trivial errors, it reveals apparent discrepancies and inconsistencies upon close inspection. The formal kinetics are fairly well presented, but the viewpoints subsequently expressed, such as the frequent implication that a rate of volatilization depending linearly on the mass of polymer (so-called "first order") proves chain end initiation, are often not tenable. In the appendix the afore-mentioned behavior suddenly means independence of rate of volatilization—that is, monomer formation—of chain length. An additional conclusion that the degradation of polystyrene initiates at chain ends is also on a highly tenuous basis in my opinion. It is felt that in view of possible variations owing to different methods of polymer preparation, all conclusions on decomposition mechanisms should have been extensively qualified. Although this consideration is mentioned, relatively briefly, it appears to have been forgotten in many cases.

The author, in general, makes many positive statements without qualification, ignoring in the process possible alternative mechanisms. In this respect, the book is somewhat superficial. For the worker new to the field it should provide an excellent starting point, the coverage of the literature being as complete as could reasonably be expected.

LEO A. WALL
Polymer Structure Section,
National Bureau of Standards

Advances in Food Research. vol. V. E. M. Mrak and G. F. Stewart, Eds. Academic Press, New York, 1954. x + 538 pp. Illus. $11.50.

Like the preceding volumes in this series, volume V gives a masterful coverage of certain scientific and technologic aspects of foods. There are seven articles dealing with various fundamental and applied problems. These include the oxidative changes in fats and heme pigments that lead to rancidity and discoloration in meat, chemistry of the sugar-sulfite reaction and the use of sulfur dioxide in the preservation of fruit and vegetable products, flavonoids, color measurements, organic constituents of wines, and concepts in statistics and methods of calculation in food research. Each article is well organized and systematically presented, with a comprehensive bibliography that includes the titles. The article on wines contains approximately 1000 references.

Of the 11 authors, 10 are connected with academic institutions. One is an Englishman; the others live in the United States. Two of the writers belong to the editorial board of *Advances in Food Research.* All are specialists in the subjects for which they are responsible.

The format of the book and the quality of the writing are particularly good, but there are a few errors. Occasionally

there is lack of sufficient clarity and accuracy, as if the authors had referred to reports in the literature without verifying their sources or without thinking critically about some of the findings reviewed. For example (p. 457), it is stated that one investigator has found that "grapes supply (on the average) only 3% of the daily nutritive requirements (of vitamins, calcium, and iron) for adults." In the context of the book this has no meaning. Also, it is stated in a few places that grapes and wines contain some vitamin A. It would have been more accurate to distinguish vitamin A from precursors of this vitamin.

This volume adheres to the general objective of the series, which is "the coordination and integration of food research to promote an orderly and systematic development of scientific knowledge in this important field." The articles should be of interest and great value to a rather wide variety of persons with chemical training who are concerned with food research and technology.

HARRY G. DAY
Department of Chemistry, Indiana University

Connective Tissues. Transactions of the Fifth and Final Conference. Charles Ragan, Ed. Josiah Macy, Jr., Foundation, New York, 1955. 222 pp. Illus. + plate. $4.25.

The fifth and final Josiah Macy, Jr., Foundation conference on connective tissue is presented in three excellent chapters: "The exchange of materials between blood vessels and lymph compartments," by Benjamin Zweifach; "Interstitial water and connective tissues," by Mario Gaudino; and "Hormonal effects on connective tissues," by Gustav Asboe-Hansen.

There are actually four chapters in this volume, since a section devoted to introductory remarks consumes 24 interesting pages of repartee. In this section the participants discuss their current avenues of research and the ideas behind them.

This conference is presented in the usual verbatim form of the preceding volumes. It differs, however, in that the questions asked of the speaker, and the facts inserted by the participants are much more pertinent and informative than in some of the other conferences.

The factual and speculative material presented is so diversified and yet so relevant to the problems being discussed that I find it next to impossible to amplify upon or summarize the data given. The lists of references after each chapter are quite adequate. An index to subjects covered in all five conferences is included in this volume.

In contrast to the report of the Fourth Conference on Connective Tissues, *this* volume is a definite contribution to the general field of connective tissues.

JOHN A. ARCADI
The James Buchanan Brady Urological Institute, Johns Hopkins Hospital

New Books

Trees and Shrubs of the Upper Midwest. Carl Otto Rosendahl. Univ. of Minnesota Press, Minneapolis, rev. ed. 2, 1955. 411 pp. $6.

Essentials of Biological and Medical Physics. Ralph W. Stacy, David T. Williams, Ralph E. Worden, and Rex O. McMorris. McGraw-Hill, New York–London, 1955. 586 pp. $8.50.

Highway to the North. Frank Illingworth. Philosophical Library, New York, 1955. 293 pp. $7.50.

Laboratory Studies in Biology: Observations and Their Implications. Chester Lawson, Ralph Lewis, Mary Alice Burmester, and Garrett Hardin. Freeman, San Francisco, 1955. 328 pp. $3.50.

Everything and the Kitchen Sink. How the first century of industry created our first century of good living. Farrar, Straus & Cudahy, New York, 1955. 160 pp. $4.

Horticultural Science. A reading and laboratory manual. Gordon T. Nightingale. Horticultural Publications, Rutgers Univ., New Brunswick, N.J., 1955. 111 pp.

Dielectric Behavior and Structure. Dielectric constant and loss, dipole moment and molecular structure. Charles Phelps Smyth. McGraw-Hill, New York–London, 1955. 441 pp. $9.

The Pharmacological Basis of Therapeutics. Louis S. Goodman and Alfred Gilman. Macmillan, New York, ed. 2, 1955. 1831 pp. $17.50.

Chemical Properties of Organic Compounds. An introduction. Elliot N. Marvell and Albert V. Logan. Wiley, New York; Chapman & Hall, London, 1955. 326 pp. $4.75.

Hydraulic Operation and Control of Machines. Ian McNeil. Ronald, New York, 1955. 324 pp. $7.50.

Technical Supplement to the Bomb Survival and You. Fred N. Severud and Kurt Bernhard. Reinhold, New York, 1955. 45 pp. $2.50.

The Interpretation of Dreams. Sigmund Freud. Trans. by James Strachey. Basic Books, New York, 1955. 692 pp. $7.50.

Scientific Method in Psychology. Clarence W. Brown and Edwin E. Ghiselli. McGraw-Hill, New York–London, 1955. 368 pp. $6.

Alcoholics Anonymous. The story of how many thousands of men and women have recovered from alcoholism. Alcoholics Anonymous, New York, ed. 2, 1955. 575 pp. $4.50.

A Statistical Study of Livestock Production and Marketing. Cowles Monogr. No. 15. Clifford Hildreth and F. G. Jarrett. Wiley, New York; Chapman & Hall, London, 1955. 156 pp. $4.50.

Miscellaneous Publications

(Inquiries concerning these publications should be addressed, not to Science, but to the publisher or agency sponsoring the publication.)

Training Highway-Department Personnel. Highway Research Bd. Bull. 103. Natl. Acad. of Sciences–Natl. Research Council, Washington, 1955. 16 pp. $0.45.

Irrigation of Cotton in Arkansas. Bull. 552. D. A. Brown, R. H. Benedict, and B. B. Bryan. Agr. Expt. Sta., Univ. of Arkansas, Fayetteville, 1955. 40 pp.

National Sanitation Foundation. Ten year report, 1945–54. School of Public Health, Univ. of Michigan, Ann Arbor, 1955. 96 pp.

Hydrocarbon Losses from the Petroleum Industry in Los Angeles County. Rpt. No. 5. Air Pollution Foundation, Los Angeles, 1955. 22 pp. $1.50.

Asia Is Our Business. Studies in business and economics, vol. 9, No. 1. Bur. of Business & Economic Research, Univ. of Maryland, College Park, 1955. 15 pp.

Amphipoda Collected at the Arctic Laboratory, Office of Naval Research, Point Barrow, Alaska. G. E. MacGintie. Smithsonian Misc. Coll., vol. 128, No. 1. Clarence R. Shoemaker. 78 pp. **Sixty-Year Weather Forecasts.** No. 3. C. G. Abbot. 22 pp. **Periodic Solar Variation.** No. 4. C. G. Abbot. 20 pp. Smithsonian Institution, Washington, 1955.

Allergy and Anaphylaxis. Keizo Nakamura. Nippon Medical School, Tokyo, Japan, 1954. 114 pp.

Unified Symbolism for World Understanding in Science, Including Bliss Symbols (Semantography) and Logic, Cybernetics and Semantics. Oliver L. Reiser. Semantography, Sydney, Australia, 1955. 52 pp.

Comparative Cost Studies of School Buildings. vol. XLVIII, No. 7. Clinton H. Cowgill. Virginia Polytechnic Inst., Eng. Expt. Sta., Blacksburg, Va., 1955. 42 pp.

Credit Courses by Television. American Council on Education, Washington 6, 1955. 50 pp. $1.

Investigations on Genetic Aspects of Carcinoma of the Stomach and Breast. Publ. in Public Health, vol. 2, No. 4. Charles M. Woolf. 85 pp. $1. **A Systematic Study of the Genus Aphytis Howard (Hymenoptera, Aphelinidae) with Descriptions of New Species.** Publ. in Entomology, vol. 10, No. 4. Harold Compere. 49 pp. $0.75. **Morphology and Biology of Sturmia harrisinae Coquillett (Diptera), a Parasite of the Western Grape Leaf Skeletonizer.** Publ. in Entomology, vol. 10, No. 5. Owen J. Smith, Paul H. Dunn, and John H. Rosenberger. Univ. of California Press, Berkeley, 1955.

Insects of Micronesia Bibliography. vol. 2. Teiso Esaki, E. H. Bryan, and J. L. Gressitt. Bernice P. Bishop Museum, Honolulu, 1955. 68 pp.

Government in Economic Life. 35th annual report. Solomon Fabricant. Natl. Bur. of Economic Research, Inc., New York, 1955. 78 pp.

Proceedings of the Third Medical Conference of Muscular Dystrophy Associations of America, Inc. The Associations, New York, 1954. 324 pp.

Scientific Meetings

Hotel Headquarters and Housing, Atlanta Meeting

The preliminary announcement of the second Atlanta meeting, 26–31 Dec., of the American Association for the Advancement of Science [*Science* **121**, 751 (1955); *The Scientific Monthly* **80**, 51 (1955)], although it named the Dinkler Plaza as AAAS headquarters hotel, was principally concerned with the programs of the 1955 meeting—as planned by 17 AAAS sections and some 38 participating societies and organizations. Approximately 25 additional societies and organizations will participate as official cosponsors of appropriate programs.

As in previous years, the focus of the Association's annual meeting will be a large convention hall, the Atlanta Municipal Auditorium. This well-designed building will be the site of the AAAS Registration-Information Center, the Visible Directory of Registrants, the AAAS Office, the Science Theatre, the Annual Exposition of Science and Industry, the Biologists' Smoker, and many of the principal sessions.

In the interest of a compact, unified meeting, most of the general events and the programs of the sections will be held at the auditorium or immediately across the street in the buildings of the Atlanta Division of the University of Georgia. The sessions of the participating societies, as far as possible, will be held in the downtown hotels, all of which are within a few blocks of the auditorium. The hotels of the Atlanta Biltmore-Georgia Tech area, 1½ miles to the north, are linked to the downtown hotels by the trackless trolleys that run along Peachtree Street; it is also planned to operate AAAS-chartered buses between the hotels and the auditorium, and to and from Atlanta University on the evening of the AAAS presidential address and reception there.

The technical or program sessions and the special sessions or evening lectures are open to all interested persons. Although registration for these is not mandatory, it is expected that all who attend will wish to pay the AAAS registration fee of $2.50 (unchanged in recent years) and be a part of the meeting in all respects. Each registrant receives a Convention Badge, the book-size General Program-Directory, convention literature, and listing in the Visible Directory of Registrants. Also as usual, the exhibits, AAAS Science Theatre, the Biologists' Smoker, and the presidential reception are open to all registrants.

A variety of dormitory units, rooms, and suites are available at Atlanta University; a *limited* number of dormitory units are available at the Georgia Institute of Technology, two men in a room at $2.50 each per night. Applications for dormitory accommodations should be sent directly to the academic institution's Housing Office.

Because of existing local laws, separate hotel and motel accommodations are named for Negro members and visitors. These are the Royal Hotel and Savoy Hotel, both on Auburn Avenue a few blocks from the Municipal Auditorium, and the University Motel, which is near Atlanta University.

Beginning with this issue, the advertising section of *Science* will carry, at frequent intervals, page announcements of all housing facilities and their current rate schedules, together with a coupon, which should be filled out and sent not to a hotel directly but to the AAAS Housing Bureau in Atlanta.

All applications will be filled in the order of their receipt. Those who apply early are assured of the hotel of their first choice, if the stated desired and maximum rates are within the printed rate schedules. In Atlanta there is an adequate supply of rooms at a wide range of rates. It would be well to consider, however, that, as in any city, the supply of single rooms at minimum rates is relatively limited and higher priced singles and double rooms for single occupancy are more plentiful. Thus, it is suggested that both *maximum rate* and preferred rate be stated on your coupon. Expenses can always be reduced if rooms or suites are shared by two or more persons.

A person's preference may be the hotel named as the headquarters of his section or society, but, in each of the two zones, the hotels are conveniently close to one another. It is helpful to name at least a second choice of hotel. The headquarters of the 17 sections and participating societies follow (the societies are grouped in the same sequence as the letters of the sections).

Downtown Zone

Dinkler Plaza (600 rooms), 98 Forsyth St., NW: AAAS; Press; AAAS Sections F, I, Q; American Society of Parasitologists, Herpetologists League, Society of Systematic Zoology; American Society of Naturalists, Association of Southeastern Biologists, Ecological Society of America, National Association of Biology Teachers, Society of General Physiologists; Society for Research in Child Development; AAAS Cooperative Committee on the Teaching of Science and Mathematics, American Educational Research Association, Central Association of Science and Mathematics Teachers, International Council for Exceptional Children, National Association for Research in Science Teaching, National Science Teachers Association; Academy Conference, American Nature Study Society, Conference on Scientific Editorial Problems, National Association of Science Writers, Scientific Research Society of America, Society of the Sigma Xi, United Chapters of Phi Beta Kappa

Henry Grady (550 rooms), 210 Peachtree St., NW: AAAS Sections C, N, Np; Alpha Chi Sigma, American Association of Clinical Chemists; American Chemical Society, Georgia Chapter; Alpha Epsilon Delta, American Academy of Forensic Sciences, American Association of Hospital Consultants, American Physiological Society, American Psychiatric Association; American Association of Colleges of Pharmacy, American College of Apothecaries, American Pharmaceutical Association, Scientific Section, and American Society of Hospital Pharmacists

Peachtree on Peachtree (200 rooms), 176 Peachtree St., NW: AAAS Section E; Association of American Geographers, Geological Society of America, National Geographic Society

Piedmont (450 rooms), 108 Peachtree St., NW: Georgia Minerals Society; National Speleological Society

Georgia (300 rooms), 114 Luckie St., NW: AAAS Section Nd; American College of Dentists, American Dental Association, International Association for Dental Research, American Division

Atlantan (300 rooms), 111 Luckie St., NW

Hampton (125 rooms), 35 Houston St., NE

Imperial (150 rooms), 355 Peachtree St., NE

Jefferson (125 rooms), 87 Pryor St., SW

Hotels for Negroes

Royal, 214 Auburn Ave., NE

Savoy, 239 Auburn Ave., NE

University Motel, 55 Northside Drive, NW

Georgia Tech Zone

Atlanta Biltmore (600 rooms), 817 W. Peachtree St., NE: AAAS Sections A, B, D, G, M, O; American Meteorological Society, Oak Ridge Institute of

Nuclear Studies, Sigma Pi Sigma; American Phytopathological Society, APS, Southern Division, American Society of Plant Physiologists, Southern Section, Botanical Society of America, Southeastern Section; Conference on Scientific Manpower, Engineering Manpower Commission, Scientific Manpower Commission; visiting members, Association of Southern Agricultural Workers; American Geophysical Union, International Geophysical Year

Georgian Terrace (300 rooms), 659 Peachtree St., NE: AAAS Sections K, L, P; National Academy of Economics and Political Science, Society for the Advancement of Criminology; Philosophy of Science Association, Society for the Advancement of General Systems Theory, Southern Society for Philosophy and Psychology

Cox-Carlton (150 rooms), 683 Peachtree St., NE

Peachtree Manor (125 rooms), 826 Peachtree St., NE

Advance registration and advance copies of the General Program-Directory. As in past years, those who plan to attend the meeting may register in advance and receive both a Convention Badge and a copy of the General Program-Directory, by first-class mail, early in December. The registration fee of $2.50 includes postage. Those who cannot attend the meeting but would like an advance copy of the General Program-Directory may also obtain it by first-class mail early in December at cost—$1.50. A coupon covering both alternatives will be found on another page in the advertising section of this issue. The appropriate square should be checked.

Sectional sessions for contributed papers. Ten sections of the Association will arrange sessions for contributed papers at the Atlanta meeting. The secretaries to whom titles and brief abstracts should be sent, *not later than 30 Sept. 1955,* follow.

C—Chemistry: Dr. Ed. F. Degering, 26 Robinhood Road, Natick, Mass.

D—Astronomy: Dr. Frank K. Edmondson, Goethe Link Observatory, Indiana University, Bloomington, Ind.

E—Geology and Geography: Dr. Robert L. Nichols, Department of Geology, Tufts College, Medford, Mass.

F—Zoological Sciences (if outside the scope of the American Society of Parasitologists and the Society of Systematic Zoology, which are meeting with the AAAS): Dr. Harold H. Plough, Department of Biology, Amherst College, Amherst, Mass.

G—Botanical Sciences (if outside the scope of the American Phytopathological Society, which is meeting with the AAAS): Dr. Barry Commoner, Henry Shaw School of Botany, Washington University, St. Louis, Mo.

I—Psychology: Dr. William D. Neff, Department of Psychology, University of Chicago, Chicago, Ill.

L—History and Philosophy of Science: Dr. Jane M. Oppenheimer, Department of Biology, Bryn Mawr College, Bryn Mawr, Pa.

Nd—Dentistry: Dr. Russell W. Bunting, School of Dentistry, University of Michigan, Ann Arbor

Np—Pharmacy: Dr. John E. Christian, School of Pharmacy, Purdue University, Lafayette, Ind.

Q—Education: Dr. Dean A. Worcester, University of Nebraska, Lincoln

RAYMOND L. TAYLOR

AAAS, Washington, D.C.

▪ The 2nd Plant Diseases Conference, convened by the Commonwealth Scientific and Industrial Research Organization at the request of the Australian Agricultural Council, met 27 June–1 July at Hawkesbury Agricultural College, Richmond, New South Wales. Sixty delegates were present from the Departments of Agriculture of all States, C.S.I.R.O., several commonwealth departments, the faculties of agriculture of Australian universities, and commercial organizations interested in the development and marketing of fungicides and plant protectants.

In officially opening the conference, R. J. Noble, undersecretary and director of the New South Wales Department of Agriculture, remarked on the great advances that had been made in the study of plant diseases and the great savings in crop production that had resulted. Among the many problems discussed at the conference was that of diseases of pasture plants. These plants are of great importance in the Australian economy, and their diseases had previously received relatively meager study.

▪ The American Heart Association urges early registration for those planning to attend all or part of the sessions at its annual meeting in New Orleans, 22–28 Oct. Registration forms are available from the AHA, 44 E. 23 St., New York 10.

Society Elections

▪ American Society for Testing Materials: pres., Claire H. Fellows, Detroit Edison Co.; v. pres., R. T. Kropf, Belding Heminway Co., New York.

▪ American Society of Limnology and Oceanography, Pacific Section: pres., John C. Marr, South Pacific Fisheries Investigation, P.O. Box 271, La Jolla, Calif.; v. pres., K. O. Emery, University of Southern California; sec.-treas., M. Rattray, Jr., University of Washington. Marr and Rattray are representatives to the AAAS council.

▪ American Association of Clinical Chemists: pres., Otto Schales, Alton Ochsner Medical Foundation, New Orleans 15, La.; v. pres., Robert M. Hill, University of Colorado; sec., Max M. Friedman, Lebanon Hospital, New York 57; treas., Louis B. Dotti, St. Luke's Hospital, New York 25.

▪ American Association of Neuropathologists: pres., Webb Haymaker; v. pres., Ben Lichtenstein; sec.-treas., Leon Roizin, New York, N.Y.

▪ AAAS, Southeast Branch, Alaska Division: pres., Amos J. Alter, Division of Sanitation and Engineering, Alaska Department of Health; v. pres., Donald Burrus, Alaska Native Arts and Crafts Clearing House; sec.-treas., Rosemary A. Allen, Alaska Historical Library and Museum, Juneau.

▪ American Neurological Association: pres., J. M. Nielsen, Los Angeles, Calif.; pres.-elect, H. Houston Merritt, Neurological Institute, New York; 1st v. pres., James W. Kernohan; 2nd v. pres., Robert B. Aird; sec.-treas., Charles Rupp, Philadelphia, Pa.; asst. sec., William F. Caveness.

Forthcoming Events

August

20–31. American Physical Soc., Mexico City, Mexico. (K. K. Darrow, Columbia Univ., New York 27.)

22–23. Electronics and Automatic Production Symposium, San Francisco, Calif. (W. D. McGuigan, Stanford Research Inst., Palo Alto, Calif.)

22–9. Wool Textile Research Conf., Sydney, Australia. (F. G. Nicholls, Commonwealth Scientific and Industrial Research Organization, 314 Albert St., East Melbourne, Australia.)

29–2. Infrared Spectroscopy Inst., 6th annual Nashville, Tenn. (N. Fuson, ISI, Fisk Univ., Nashville 8.)

29–3. Mathematical Assoc. of America, Ann Arbor, Mich. (H. M. Gehman, Univ. of Buffalo, Buffalo 14, N.Y.)

29–5. International Astronomical Union, Dublin, Ireland. (P. T. Oosterhoff, IAU, Leiden Observatory, Leiden, Netherlands.)

29–6. International Horticultural Cong., 14th, The Hague, Netherlands. (G. de Bakker, International Comm. for Horticulture, Bezuidenhoutseweg 30, The Hague.)

30–31. Soc. for Industrial and Applied Mathematics, 2nd general, Ann Arbor, Mich. (G. W. Preston, Research Div., Philco Corp., Philadelphia 34, Pa.)

30–2. American Mathematical Soc., 60th summer, Ann Arbor, Mich. (AMS, 80 Waterman St., Providence 6, R.I.)

30–2. Biological Photographic Assoc., 25th annual, Milwaukee, Wis. (L. C. Massopust, Sr., Marquette Univ. School of Medicine, Milwaukee 3.)

31–1. Conf. on Low Temperature Physics, Paris, France. (L. Weil, Institut Fourier, Place du Doyen Gosse, Grenoble, Isère, France.)

31–2. American Sociological Soc., Washington, D.C. (W. J. Warner, ASS, New York Univ., Washington Sq., New York 3.)

31–3. United Chapters of Phi Beta Kappa, 24th triennial, Minneapolis, Minn. (C. Billman, 1811 Q St., NW, Washington 9.)

31–6. International Assoc. for Hydraulic Research, 6th plenary, The Hague, Netherlands. (L. G. Straub, St. Anthony Falls Hydraulic Lab., Minneapolis 14, Minn.)

31–7. British Assoc. for the Advancement of Science, annual, Bristol, Eng. (BAAS, Burlington House, London, W.1.)

31–8. International Cong. of Refrigeration, Paris, France. (L. Weil, Institut Fourier, Place du Doyen Gosse, Grenoble, Isère, France.)

September

1. Assoc. for Symbolic Logic, Ann Arbor, Mich. (J. Barlaz, Rutgers Univ., New Brunswick, N.J.)

2–7. American Psychological Assoc., San Francisco, Calif. (F. H. Sanford, APA, 1333 16 St., NW, Washington 6.)

2–7. Psychometric Soc., San Francisco, Calif. (J. B. Carroll, Harvard Univ., 13 Kirkland St., Cambridge 38, Mass.)

2–9. International Cong. of Anthropological and Ethnological Sciences, 5th, Philadelphia, Pa. (A. Kidder, Univ. of Pennsylvania, Philadelphia 4.)

3–7. International Council of Women Psychologists, San Francisco, Calif. (M. G. Reiman, Milwaukee County Guidance Clinic, Milwaukee 3, Wis.)

4–7. International Cong. of Vitamin E, 3rd, Venice, Italy. (K. E. Mason, Dept. of Anatomy, Univ. of Rochester School of Medicine and Dentistry, 260 Crittenden Blvd., Rochester 20, N.Y.)

4–11. International Cong. of Historical Sciences, 10th, Rome, Italy. (F. Chabod, X^e Congres International des Sciences Historiques, Université, Rome.)

5–8. American Soc. for Pharmacology and Experimental Therapeutics, Iowa City, Iowa. (C. C. Pfeiffer, Dept. of Pharmacology, Emory Univ., Emory University, Ga.)

5–9. American Inst. of Biological Sciences, Michigan State Univ., East Lansing, Mich. (H. T. Cox, AIBS, 2000 P St., NW, Washington 6.)

The following 24 societies will hold their meetings along with the AIBS during the same week at East Lansing, Mich.

American Bryological Soc. (L. J. Gier, Dept. of Biology, Wm. Jewell College, Liberty, Mo.)

American Fern Soc. (M. E. Faust, 501 University Pl., Syracuse 10, N.Y.)

American Microscopical Soc. (C. J. D. Brown, Dept. of Zoology and Entomology, Montana State College, Bozeman.)

American Soc. for Horticultural Science. (F. S. Howlett, Ohio Agr. Exptl. Sta., Wooster.)

American Soc. of Human Genetics. (D. C. Rife, Ohio State Univ., Columbus.)

American Soc. of Limnology and Oceanography. (B. H. Ketchum, Woods Hole Oceanographic Inst., Woods Hole, Mass.)

American Soc. of Naturalists. (W. P. Spencer, Dept. of Genetics, Univ. of Texas, Austin 12.)

American Soc. of Plant Physiologists. (J. F. Stanfield, Dept. of Botany, Miami Univ., Oxford, Ohio.)

American Soc. of Plant Taxonomists. (R. C. Rollins, Gray Herbarium, Harvard Univ., Cambridge 38, Mass.)

American Soc. of Zoologists. (R. C. Kempton, Dept. of Zoology, Vassar College, Poughkeepsie, N.Y.)

Beta Beta Beta. (B. R. Weimer, Bethany College, Bethany, W.Va.)

Biometric Soc. (C. I. Bliss, Box 1106, New Haven 4, Conn.)

Botanical Soc. of America. (H. C. Bold, Dept. of Biology, Vanderbilt Univ., Nashville, Tenn.)

Ecological Soc. of Ameria. (J. F. Reed, Dept. of Botany, Univ. of Wyoming, Laramie.)

Genetics Soc. of America. (C. P. Oliver, Dept. of Zoology, Univ. of Texas, Austin.)

Mycological Soc. of America. (E. S. Beneke, Botany and Plant Pathology Dept., Michigan State Univ., East Lansing.)

National Assoc. of Biology Teachers. (P. V. Webster, Bryan City Schools, Bryan, Ohio.)

Nature Conservancy. (G. B. Fell, 4200 22 St., NE, Washington 18.)

(Continued on page 169)

(Continued from page 167)

Phycological Soc. (P. C. Silva, Dept. of Botany, Univ. of Illinois, Urbana.)

Potato Assoc. of America. (R. W. Hougas, Dept. of Genetics, Univ. of Wisconsin, Madison 6.)

Soc. for Industrial Microbiology. (C. L. Porter, Dept. of Biological Sciences, Purdue Univ., West Lafayette, Ind.)

Soc. of Protozoologists. (N. D. Levine, College of Veterinary Medicine, Univ. of Illinois, Urbana.)

Soc. for the Study of Evolution. (H. Lewis, Dept. of Botany, Univ. of California, Los Angeles 24.)

Soc. of Systematic Zoologists, (R. E. Blackwelder, 3728 Second St. South, Arlington 4, Va.)

5–9. Econometric Soc., Ann Arbor, Mich. (R. Ruggles, Box 1264, Yale Station, New Haven, Conn.)

5–10. World Cong. of Anaesthesiologists, Scheveningen, Netherlands. (W. A. Fentener van Vlissingen, WCA, Bilthoven, Netherlands.)

6–11. American Physiological Soc., Boston, Mass. (M. O. Lee, APS, 9650 Wisconsin Ave., Washington 14.)

6–16. Chicago Inst. for Hospital Administrators, 23rd, Chicago, Ill. (American College of Hospital Administrators, 620 N. Michigan Ave., Chicago 11.)

7–9. American Political Science Assoc., Boulder, Colo. (E. M. Kirkpatrick, 1785 Massachusetts Ave., NW, Washington 6.)

7–9. American Soc. of Photogrammetry, Los Angeles, Calif. (C. E. Palmer, 1000 11 St., NW, Washington 1.)

9–10. Soc. of General Physiologists, Woods Hole, Mass. (J. B. Buck, NIH, Bethesda 14, Md.)

9–10. Symposium on Electroluminescence and Photoconduction in Inorganic Phosphors, Brooklyn, N.Y. (J. J. Dropkin, Polytechnic Inst. of Brooklyn, Brooklyn 1.)

9–12. Sigma Delta Epsilon, Minneapolis, Minn. (Mary Gojdics, Barat College, Lake Forest, Ill.)

10. International Conf. of Medical and Reference Librarians, Brussels, Belgium. (Miss C. de Looze, Oeuvre Nationale Belge de Defense contre la Tuberculose, 56, rue de la Concorde, Bruxelles.)

10–11. Soc. for Social Responsibility in Science, annual, Swarthmore, Pa. (J. Engelberg, 4715 Baltimore Ave., Philadelphia 43, Pa.)

10–15. International Cong. on Cosmic Radiation, Mexico, D.F., Mexico. (H. A. Barton, IUPAP, 57 E. 55 St., New York 22.)

11–16. American Chemical Soc., Minneapolis, Minn. (A. H. Emery, 1155 16 St., NW, Washington 6.)

11–16. Laurentian Hormone Conf. AAAS, annual, Estes Park, Colo. (Committee on Arrangements, 222 Maple Ave., Shrewsbury, Mass.)

11–18. International Cong. of Criminology, London, Eng. (State Univ. of New York, College of Medicine at New York City, 469 Clarkson Ave., Brooklyn 3.)

11–18. International Cong. of Librarianship and Documentation, Brussels, Belgium. (M. A. Baby, 8, rue de Haguenau, Strasbourg, France.)

(See issue of 15 July for more comprehensive listings.)

GET YOUR ADVANCE COPY

of the General Program-Directory of the AAAS Atlanta Meeting by first class mail – early in December

The General Program-Directory of the 122nd Meeting of the AAAS in Atlanta, Georgia, Dec. 26–31, 1955, will be available to anyone, at cost, within the first week in December—whether he can attend the Meeting or not. You will want the General Program-Directory for your reference shelf.

Program content

1. The four-session symposium, "Atomic Energy and Agriculture," arranged by ORINS.
2. The three-session program of the International Geophysical Year.
3. An AAAS-sponsored "Congress" on the shortage of young scientists and science teachers.
4. Programs of the 17 AAAS sections (symposia and contributed papers).
5. Programs of the more than 60 participating societies.
6. The Special Sessions: AAAS, Academy Conference, Conference on Scientific Editorial Problems, National Geographic Society, Phi Beta Kappa, RESA, Sigma Xi.
7. Details of the Municipal Auditorium—center of the Meeting—and hotels and campuses.
8. Titles of the latest foreign and domestic scientific films to be shown in the AAAS Science Theatre.
9. Exhibitors in the 1955 Annual Exposition of Science and Industry and descriptions of their exhibits.

Directory content

1. AAAS officers, staff, committees for 1955.
2. Complete roll of AAAS presidents and their fields.
3. The more than 265 affiliated organizations.
4. Historical sketch and organization of the Association; the Constitution and Bylaws.
5. Publications of the Association.
6. AAAS Awards and Grants—including all past winners.
7. Membership figures by sections.
8. Section committees (Council members) in detail.
9. Local committees.
10. Future Meetings of the AAAS through 1962.
11. New and current activities of the AAAS.

Advance Registration

Advance registration has these decided advantages: 1) You avoid delay at the Registration Center upon arrival; 2) You receive the General Program-Directory in ample time to decide, unhurriedly, which events and sessions you particularly wish to attend; 3) Your name is posted in the Visible Directory as the Meeting opens.

The following coupon may be used both by advance registrants and by those who wish only the advance copy of the General Program-Directory.

— THIS IS YOUR COUPON FOR AN ADVANCE COPY OF THE GENERAL PROGRAM-DIRECTORY —

1a. ☐ Enclosed is $2.50 for my advance Registration Fee which brings me the Program-Directory, Convention Badge, and all privileges of the Meeting.

1b. ☐ Enclosed is $1.50 for only the Program-Directory. (It is understood that, if I should attend the Meeting later, the Badge—which is necessary for all privileges of the Meeting—will be secured for $1.00 more.)
(Check one)

2. FULL NAME (Dr., Miss, etc.) ....
(Please print or typewrite) (Last) (First) (Initial)

3. ACADEMIC, PROFESSIONAL, OR BUSINESS CONNECTION ....

4. OFFICE OR HOME ADDRESS ....
(For receipt of Program-Directory)

5. YOUR FIELD OF INTEREST ....

6. CONVENTION ADDRESS ....
(May be added later, after arrival)

Please mail this Coupon and your check or money order for $2.50 or $1.50 to the
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
1025 Connecticut Avenue, N.W., Washington 6, D. C.

APPLICATION FOR HOTEL RESERVATIONS

122nd AAAS MEETING

Atlanta, Ga., December 26-31, 1955

The list of hotels and their rates and the reservation coupon below are for your convenience in making your hotel room reservation in Atlanta. Please send your application, *not* to any hotel directly, but to the AAAS Housing Bureau in Atlanta and thereby avoid delay and confusion. The experienced Housing Bureau will make assignments promptly; a confirmation will be sent you in two weeks or less. **As in any city, single-bedded rooms may become scarce; double rooms for single occupancy cost more; if possible, share a twin-bedded room with a colleague—and also save money.** Mail your application *now* to secure your first choice of desired accommodations. All requests for reservations must give a definite date and estimated hour of arrival, and also probable date of departure.

HOTELS AND RATES PER DAY

★ **Hotels starred have sessions in their public rooms.** Most hotels will place comfortable rollaway beds in rooms or suites at 2.50 or 3.00 per night. For a list of headquarters of each participating society and section—and for information on **dormitory accommodations** at Atlanta University and Georgia Institute of Technology—please see *Science,* July 22, or *The Scientific Monthly,* August.

Hotel★	Single	Double Bed	Twin Bed	Suite
Georgia Tech Zone				
Atlanta Biltmore★	6.00–10.00	8.00–14.00	10.00–14.00	15.00–50.00
Cox-Carlton	4.00– 6.00	6.00– 8.00	6.00– 8.00	14.00–16.00
Georgian Terrace	5.00– 8.00	8.50–11.00	8.50–12.00	12.00–22.00
Peachtree Manor	5.00– 8.00	7.50– 9.50	8.50–12.00	15.00–28.00
Downtown Zone				
Atlantan	4.00– 5.50	6.00– 8.50	8.50–10.50	17.00
Dinkler Plaza★	6.00– 8.50	7.00–11.50	13.00–15.00	12.00–35.00
Georgia★	4.00– 7.00	6.00– 9.00	7.00–10.00	15.00–20.00
Hampton	2.50– 4.00	3.50– 5.00	5.00– 7.00	
Henry Grady★	5.50–12.00	9.00–12.00	9.50–12.00	16.00–25.00
Imperial	4.00– 5.50	6.00– 6.50	6.50– 7.00	
Jefferson	3.00– 3.50	4.00– 5.00	4.50– 5.00	
Peachtree on Peachtree	5.00– 7.00	7.50–10.50	8.50–10.50	10.00–18.00
Piedmont★	5.50– 8.00	7.50–10.00	10.00–14.00	20.00–25.00

As required by local laws, the following are available for Negro members and visitors:

	Single	Double Bed
Royal Hotel, 214 Auburn Ave., N.E.	4.00	5.00
Savoy Hotel, 239 Auburn Ave., N.E.	2.50	3.50– 4.50
University Motel, 55 Northside Drive, N.W.	5.00	8.00

---------------THIS IS YOUR HOTEL RESERVATION COUPON---------------

AAAS Housing Bureau
Room 912, Rhodes-Haverty Bldg.
Atlanta 3, Ga.

Date of Application ....

Please reserve the following accommodations for the 122nd Meeting of the AAAS in Atlanta, Dec. 26–31, 1955:

TYPE OF ACCOMMODATION DESIRED

Single Room .... Desired Rate .... Maximum Rate ....

Double-Bedded Room .... Desired Rate .... Maximum Rate .... Number in party ....

Twin-Bedded Room .... Desired Rate .... Maximum Rate ....

Suite .... Desired Rate .... Maximum Rate .... Sharing this room will be:

(Attach list if this space is insufficient. The name and address of each person, including yourself, must be listed.)

....

....

First Choice Hotel .... **Second Choice Hotel** .... **Third Choice Hotel** ....

DATE OF ARRIVAL .... DEPARTURE DATE ....
(These must be indicated—add approximate hour, a.m. or p.m.)

NAME ....
(Individual requesting reservation) (Please print or type)

ADDRESS ....
(Street) (City and Zone) (State)

Mail this now to the Housing Bureau. **Rooms will be assigned and confirmed in order of receipt of reservation.**

PERSONNEL PLACEMENT

YOUR ad here reaches over 32,000 foremost scientists in the leading educational institutions, industrial laboratories, and research foundations in the U. S. and 76 foreign countries—at a very low cost.

CLASSIFIED: 18¢ per word, minimum charge $3.60. Use of Box Number counts as 10 additional words.

DISPLAY: Rates listed below — no charge for Box Number. Monthly invoices will be sent on a charge account basis—provided that satisfactory credit is established.

Single insertion	**$19.50 per inch**
7 times in 1 year	**17.50 per inch**
13 times in 1 year	**16.00 per inch**
26 times in 1 year	**14.00 per inch**
52 times in 1 year	**12.50 per inch**

For PROOFS on display ads, copy must reach SCIENCE 4 weeks before date of issue (Friday of every week).

POSITIONS WANTED

Abstractor, all biological sciences. Contract basis, full or part time. Box 204, SCIENCE. X

(a) **Anatomist,** Ph.D.; full-time teaching since 1931; past 6 years, associate professor, university medical school. (b) **Bacteriologist;** Ph.D.; three years, research assistant, university department of bacteriology–virology. Medical Bureau (Burneice Larson, Director), Palmolive Building, Chicago. X

Bacteriologist, Ph.D.; since 1948 senior bacteriologist and administrative assistant to research director; has been associated with the organic chemistry and pharmacology divisions in the research and development of new therapeutics and pharmaceuticals. Medical Bureau (Burneice Larson, Director), Palmolive Building, Chicago. X

Biochemist, M.S., 2 years clinical experience. Worked with paper chromatography and radioactive carbon. Clinical or research position in East. Box 203, SCIENCE. X

POSITIONS WANTED

Biologist; Ph.D. 30. General and cellular physiology, endocrinology, embryology, invertebrates, vertebrates, genetics, evolution, general biology, botany, and zoology. Teaching experience. Desires teaching and/or research. Box 201, SCIENCE. X

Ph.D. (Physiology); 3 years research experience, isotopes, biochemistry; age 29. Box 205, SCIENCE. X

Vertebrate Zoologist, Ph.D. (Zoology), specializing in mammalian Anatomy and Physiology, with college teaching experience, publications. Desires teaching and/or research position for 1 year or longer. Would accept position outside U.S.A. Box 206, SCIENCE. X

POSITIONS OPEN

(a) **Bacteriologist** qualified to instruct medical students; preferably Ph.D. trained in mycology or parasitology; state university; Midwest. (b) **Pharmacist,** preferably with M.S. but one with B.S. and several years' experience eligible and, also, **pharmacist,** trained in bacteriology; faculty appointments, state university college of pharmacy; Midwest. (c) **Parasitologist;** medical school research department; Midwest. (d) **Pharmacologist,** Ph.D. or M.D., well grounded in pharmacodynamics, to head operating division of pharmacology, pharmaceutical company; new research laboratory; East. S7-4 Medical Bureau (Burneice Larson, Director), Palmolive Building, Chicago. X

Biophysicist–Electrophysiologist, Ph.D. or equivalent. Experience with bioelectric potentials and electronics desirable. For university research position. Academic rank and salary to $6,000 according to training and experience. Box 177, SCIENCE. 7/29, 8/5, 12

Biochemist, recent Ph.D., join research team doing basic biochemical and immunological work in hypersensitivity. Good opportunity for interesting career. Write background fully, salary expected. Dr. S. M. Feinberg, Allergy Research Laboratory, Northwestern University Medical School, Chicago. 7/22

POSITIONS OPEN

(a) **Biochemist;** M.S.; good methodology training; large general hospital; city 200,000. (b) **Microbiologist;** M.S. preferred; specific interest in virology, experienced virus assays; assay biological compounds, materials for viricidal and protective activities; pharmaceutical house. (c) **Bacteriologist;** M.S.; duties include pathogen isolation, identification; 400-bed hospital; Midwest. (d) **Research Technician;** biochemistry department; B.S.; to $4,200; East. (e) **Biochemist;** Ph.D.; head new diagnostic clinic laboratory service; direct technicians; research enzyme, steroid chemistry; $8,000; Mideast. Woodward Medical Personnel Bureau, 185 N. Wabash, Chicago. X

(a) **Two Board internists** qualified hematology or nutrition and three **internists** experienced clinical medicine; research department; large company; day off weekly for teaching and clinical medicine; East; $12,000–$15,000. (b) **Pharmacologist;** full-time teaching; Midwest; $6,000–$8,000. (c) **Assistant professor, biochemistry;** duties including teaching advanced course in nutritional biochemistry, directing graduate student research; state university. (d) **Clinical psychologist;** industrial company, East. (e) **Biochemist;** new voluntary general hospital, 250 beds; duties include teaching; Midwest. S7-3 Medical Bureau (Burneice Larson, Director), Palmolive Building, Chicago. X

Editors, free-lance, for German-English technological dictionary in preparation, experts in all major fields. For checking and editing compiled manuscript. New York area preferred. Frederick Ungar Publishing Co., 105 East 24 Street, New York 10. X

Fellow to participate in new pulmonary project in pediatric patients. Opportunity for concurrent study for Ph.D. in physiology department at University of Southern California, if student is satisfactory. Box 202, SCIENCE. X

Physiologist. Ph.D. in physiology with interest in neurophysiology to serve as member of research project team in evaluation of scientific data for research and development division of pharmaceutical firm. Philadelphia location. Send complete record of education and experience. Box 189, SCIENCE. 7/15, 22

The MARKET PLACE

BOOKS · SERVICES · SUPPLIES · EQUIPMENT

CLASSIFIED: 25¢ per word, minimum charge $6.00. Use of Box Number counts as 10 additional words. Correct payment to SCIENCE must accompany ad.

DISPLAY: Rates listed below—no charge for Box Number. Monthly invoices will be sent on a charge account basis—provided that satisfactory credit is established.

Single insertion	**$19.50 per inch**
7 times in 1 year	**17.50 per inch**
13 times in 1 year	**16.00 per inch**
26 times in 1 year	**14.00 per inch**
52 times in 1 year	**12.50 per inch**

For PROOFS on display ads, copy must reach SCIENCE 4 weeks before date of issue (Friday of every week).

BOOKS AND MAGAZINES

WANTED TO PURCHASE . . .
SCIENTIFIC PERIODICALS and BOOKS
Sets and runs, foreign and domestic. Entire libraries and smaller collections wanted
WALTER J. JOHNSON • 125 East 23rd St., New York 10, N. Y.

Your sets and files of scientific journals
are needed by our library and institutional customers. Please send us lists and description of periodical files you are willing to sell at high market prices. Write Dept. A3S, J. S. CANNER, INC. Boston 19, Massachusetts

BOOKS AND MAGAZINES

BACK NUMBER PERIODICALS— Bought and Sold
• Tell us what you want?—What have you to offer?
Abrahams Magazine Service Established 1889
DEPT. P, 56 E. 13th ST. NEW YORK 3, N. Y.

PROFESSIONAL SERVICES

WISCONSIN ALUMNI RESEARCH FOUNDATION

LABORATORY SERVICES

Project research and consultation in Biochemistry, Chemistry, Bacteriology and Entomology

Mineral determinations including sodium and fluorine • Proximate analyses • Vitamin and amino acid assays • Food chemistry and microbiology • Enzyme investigations

Write for price schedule

WISCONSIN ALUMNI RESEARCH FOUNDATION
P. O. BOX 2059-V • MADISON 1, WISCONSIN

BOOK MANUSCRIPTS INVITED

Write for Free Booklet SC telling how we can publish your book. All subjects considered. New authors welcome.
VANTAGE PRESS, Inc. • 120 W. 31 St., New York 1
In Calif.: 6253 Hollywood Blvd., Hollywood 28

The MARKET PLACE

BOOKS • SERVICES • SUPPLIES • EQUIPMENT

PROFESSIONAL SERVICES

SUPPLIES AND EQUIPMENT

SUPPLIES AND EQUIPMENT